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> "Do thy little well, and for thy comfort know
> Great men can do their greatest work no better than just so."

IN spite of assertions to the contrary, there will never come a time when New Year resolutions are out of date. We may recall our own failures, and smile at the recollection of others who have "turned over a new leaf," but we cannot get away from the fact that we all have to face this problem of the new leaf, willy-nilly. We may indite a record of inefficiency this year similar to that of last—but indite something, and on a fresh page, we must. And so it is that in directing our readers' attention to the fact that this is our New Year's issue, we turn over a new leaf—page 1 of 1915,—and cast about for better things.

In presenting this number, we extend the heartiest greetings of the Season, thank our readers for their ready co-operation in the past, bespeak their interest in the future, and wish them all prosperity in 1915.

During the coming year it will be the aim of the publishers to continue an active policy in the best interests of the progressive community they serve, striving to present timely and accurate information of all happenings in the constructional world, concentrating upon engineering features and enlarging upon those details which make for more efficient work and facilitate its execution. Improvement is always possible, and what little we have accomplished in the past is but an incentive to greater attainment. During Nineteen Fifteen we shall set a higher standard of service and endeavor to maintain it. In all of which we bespeak the co-operation of the reader (sine qua non).

We set forth no lofty ideals. We reach out to no unseen goal. Our prospective attainments are well within the range of normal vision. We are content to look forward to "doing our little well,"—and, if possible, a little better.

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The War and Its Bearings on Constructional Development

ELSEWHERE in this issue we give an abstract of the introductory portion of the Presidential Address delivered recently in London, England, before the Society of Architects, by Mr. E. C. P. Monson. The article cannot fail to be found of interest, in that it discloses the same constructive purpose that we have been endeavoring to foster in this country since the outbreak of the war.

As between the situation existing in Canada and that in the Old Country there are several material differences which the reader will not fail to note; and, on the other hand, there are a number of things in common. Mr. Monson refers to increased prices and to difficulty in obtaining building material. In this misfortune Canada, happily, has not shared. We may congratulate ourselves upon the fact that at the present moment large supplies of all kinds of material are available at the most favorable prices that have obtained in years.

The Canadian contractor who thought that he had nothing to be thankful for will do well to read Mr. Monson's further observations in this regard. Let him ponder over the suggestion that in England His Majesty's Government may have to "step in and fix a maximum price for the respective materials"—in order, we are told, "to prevent grasping merchants and importers from making an inordinate profit and crippling the industry of the country." Contrast such a

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state of affairs with the conditions existing in Canada to-day!

The Chancellor of the Exchequer, one Lloyd George, is reminded of his promise to provide £4,000,000 for housing schemes. This reminds us, in turn, that our own Authorities have plenty of opportunity to open up spheres of activity for engineers, architects and contractors. Why not an insistent demand for Government undertakings in Canada?

A constructive suggestion by Mr. Monson is that of a Round Table Conference of all connected with the constructional industry. If in England, why not in Canada? What special efforts have been put forth by our architectural, engineering and building societies since the outbreak of the war? Out of such a conference there might well arise a coalition board which should not be dissolved upon the transaction of its emergency business, but continued in a career of constantly increasing usefulness in co-operative deliberation.

Mr. Monson looks to the war to bring about rigid economy in construction and a reorganization of building methods, as well as a standardization of materials. These are developments which are hardly anticipated here in Canada, although the governing principles are sound.

Lastly, we may thank a kind Providence that we do not have to regard as "a serious question" the responsibility of providing against possible damage and destruction by the enemy.

Taking all in all, the reader cannot fail to conclude, after reading Mr. Monson's interesting address, that Canada has the better of the deal. Let us not forget, then, that much is required of him to whom much is given. According to the measure of our opportunity must be the extent of our performance.

Workmen's Compensation in Ontario

A Discussion of the New Act Now In Force With a Constructive Criticism of Its Shortcomings

THE coming into operation on January 1st of the Ontario Workmen's Compensation Act suggests the discussion of a few aspects of the measure as affecting the interests represented by the Contract Record and Engineering Review.

It is of the greatest importance that the Act be thoroughly understood as regards its application to the constructional and manufacturing interests, for it is only by this means that an adequate grasp of its obvious imperfections can be obtained. The new system is in substitution for the common law liability. Employers covered by the Workmen's Compensation Act are no longer subject to legal action at the instance of injured workmen. Instead the workman looks to a Provincial Insurance Fund for his compensation. This fund is raised by assessments upon the various employers in the province. Employers are grouped in classes corresponding generally with certain allied lines of industry, and which group fund is intended to cover accidents which may occur to injured workmen identified with that group. The rates for a group, therefore, will fluctuate in proportion to the number of accidents.

The Act provides that compensation for injury must be paid to an employee regardless of considerations of negligence. The amount of compensation to be paid is to be determined with reference to the earnings of the workman serving under the employer by whom the compensation is payable, and is to be based upon percentages fixed by the Act, and in any case not to exceed fifty-five per cent. of the average monthly earnings of the workman. The amount is to be adjusted by a Government-appointed Commission, the fund being raised on the collective liability basis by means of a tax upon employers arranged in groups in accordance with the estimated hazard associated with the respective industries,—this payment to be continued during the period of disability, and, if necessary, for life. In case of death, certain fixed monthly payments are to be made to the widow during her life, or to other dependants for varying periods.

It cannot be denied that the Act, in regard to some of these provisions, is about as drastic a piece of legislation as it is possible to conceive. One of the most important of the many phases of the complexity of premium assessment is the question of a proper actuarial basis for computing premium rates. There are two plans of rating: one which may be called the capitalized plan of charging against the year's premium a sum sufficient to provide for future payments of compensation for all accidents of the year; the other, which may be called the current cost plan of merely levying each year the amount necessary to pay the year's compensation. An examination of the Act forecasts possible difficulties in the application of the assessment plan to the building trades. It is difficult to see how an industry subject to such fluctuations as the building trade can be worked out on a satisfactory assessment insurance basis. The building trade, by its very nature, is spasmodic and irregular. One week fifty carpenters may be rushing through a contract for a builder; the next week this number may be reduced to five. For eight months of the year bricklayers may be actively employed; for the remaining four months their work may be substantially curtailed. Their employer, however, would wait until the end of the year before paying his assessment, if in the meantime his premium had not been collected by a government auditor. Such a haphazard method of levying is incompatible with insurance principles.

Then, it may be asked, what about the contractor who takes one or two contracts, after which he leaves the business? How about the New York contractor, for instance, who contracts to install machinery in an Ontario factory and, having completed the work, leaves the country before the assessment day arrives? Are Ontario contractors to bear the burden of accidents which may occur to workers in the employment of such contractors, or of other builders who evade the government assessors? Our reading of the measure as it applies to the building trades would appear to confirm the supposition.

Apart altogether from these inconsistencies, the average man in present-day business is anxious to know what his liabilities are, so that he may govern himself accordingly. A builder tendering for a contract takes into consideration the cost of insurance against these liabilities, or estimates on a comfortable profit margin in order to provide for possible liabilities. An assessment basis of insuring against industrial accidents would preclude the estimating of these liabilities, since it would depend upon several factors, a few of which we have indicated. The premium basis, on the other hand, is both simple and certain. A master builder pays his premiums according to the amount and character of the tender before commencing his undertaking. His liability then is at an end. But to compel him to wait for an assessment, and possibly to bear the burdens of defaulting employers, appears to us to be most unjust. This, however, is but one of the many imperfections of the Act as it applies to the constructional interests.

Another point worth noting is the fact that there is no adequate provision for the sub-contractor. For example: who is to be responsible for an accident which occurs, let us say, to a master-painter's assistant engaged in painting a house? Is it the master builder, the contractor who is building the house, the owner for whom the house is being built, or any two or all three of them? This, we presume, will be a knotty point for the Compensation Board to adjust. Assuming, for the sake of argument, that liability in a case of this kind should fall upon the contractor, it would then be necessary for the contractor to examine the wages, etc., of all the workmen employed by the sub-contractors, to submit a complete list of all the workmen which he himself as contractor had hired in the course of the year,—a task the difficulty of which can be readily imagined. But to add to this list the multitude of workmen employed by sub-contractors would, we think, be sufficient to drive many contractors out of business. If, on the other hand, liability were fixed on the sub-contractor himself, the difficulty of obtaining complete returns would be increased owing to the problem of the small contractor. It seems to us that the only way out of the difficulty would be to place the building trades on a premium instead of an assessment basis.

A good deal of dissatisfaction has been expressed owing to the rates which have been assessed upon employers by the Workmen's Compensation Board. In many cases these rates are excessive. In inaugurating a system which imposes such an enormous burden on the industrial community, the Board might well have started with a much lower schedule of rates, and assessed again later in the year, if the conditions of the group insurance funds warranted such a step. In the State of Washington the Insurance Commission makes assessments monthly, or, at the longest, quarterly. A similar plan has been advocated and recommended for the Province of Ontario. In certain groups of employment, of course, the uniformity of the system would require to be departed from. In the contracting end, and especially in the case of the small contractor, it may be found necessary to secure a lump sum by way of security before the contract is undertaken. The reasons for this are obvious.

Classification as it affects the constructional and engineering interests has an important bearing on the general question of Insurance under the Act. We understand that the rates fixed by the Board in the appended classes are as follows:—

Class 32.—Steel building and bridge construction; installation of elevators, fire-escapes, boilers, engines or heavy machinery, $2.50 on the $100 payroll. Class 33.—Brick-laying, mason work, stone-setting, concrete work, plastering; and manufacture of concrete blocks, $2.50. Class 35.—Painting, decorating and renovating; sheet metal work and roofing, $2.00. Class 36.—Plumbing, sanitary or heating engineering, etc., $1.50. Class 37.—Sewer construction, tunnelling, shaft-sinking and well-digging, excavation work for cellars, foundations, canals, $3.50 to $6.00. Class 38.—Construction, installation or operation of telegraph or telephone lines, $2.50. There is provision in the Act for differential rating in each class, but with the exception of Class 37 the Board has practically decided to adopt uniform rates for the other classes for the first year.

It is only fair to point out that the Act is on an entirely different basis from that of the old Employer's Liability law, under which employers simply insured with insurance companies against legal liability. Under the present Act workmen are automatically compensated out of a Provincial insurance fund, receiving a substantial scale of compensation, practically irrespective of all negligence on their part. In connection with this subject it is interesting to note that the building contractors of Ontario have already taken steps to organize for the purpose of encouraging the prevention of accidents. A similar movement has been started in connection with other important lines of industry, several of which have secured charters with this end in view.

It is to be hoped that the actual operation of the Act will disclose its many shortcomings, and that in the near future amendments will be effected so that employers engaged in constructional activities may escape with a minimum of injustice.

"We have at least to thank the war . . . . for giving us the unique spectacle of representatives of all sections of the profession working together for the common good."—Mr. E. C. P. Monson in his Presidential Address before the Society of Architects (London, Eng.), abstracted elsewhere in this issue.

A French engineer, M. Mahl, has recently submitted to the Minister for Public Works in France a scheme for a suspended mono railway on which, it is claimed, speeds of 150 miles an hour or so may be attained with safety. The track, either single or double, is to be carried 20 ft. to 25 ft. above the ground by catenary suspension. The train will be composed of small sections freely articulated, and will easily take curves of 1 kilometre radius and gradients of 1 in 20. It will be propelled, of course, by electricity. Each section of the train will be suspended from two wheels placed about 1 metre apart. The seats will be placed longitudinally, and there will be but a single row of them.

Business is improving rapidly with the Dominion Iron & Steel Company, according to a report received from Sydney, C.B. The company's normal force is 3,200 employees, of whom 2,600 are now on the payroll. Quite recently the firm obtained a good-sized order for rails from Ireland. This necessitated starting a third blast furnace. The general situation at the plant is far better than was anticipated when the closing down took place in the latter part of August and over two thousand men lost their employment. It is held beyond doubt that the European demand for steel products will increase in volume from month to month. If the war continues during the year, the latter part of 1915 will find the capacity of American steel concerns taxed more heavily than ever before in their history.

The War and Its Bearing on Construction in the Old Land

[Extract from the Presidential Address of Mr. E. C. P. Monson, before the Society of Architects, of London, Eng.]

THE state of war in which we are to-day came so suddenly that although it found the State from a military point of view fully prepared and able to deal effectively with the situation, the same can hardly be said in regard to matters affecting every-day life in which the different sections of the community are individually concerned in carrying on their profession or business.

Is it possible that we may have become too engrossed in our welfare as individuals and that this war may provide an opportunity of getting as it were outside ourselves, and consequently obtaining a better perspective view of things as they really are, and of restoring that sense of their proper proportion as seen from a different and more independent standpoint?

The building industry, with which the architectural profession is so closely allied, is one of the first to feel the pinch. The state of the money market, the increase in prices, the difficulty of obtaining material, and many other questions arising, naturally affect the building owner, and through him the architect and the contractor, and it can only be by the most careful thought and nursing that contracts now running can be brought to a successful issue. Unfortunately the prices at which jobs have recently been tendered for, have been so "cut" that any little unforeseen extra, to say nothing of large ones which naturally makes the matter worse, must rapidly eat up the profits and tend to turn what might have been a margin on the right side into a bad loss. Any loss in this direction must naturally fall upon the builder and be a matter of most serious consideration to him, and often cause him some uneasiness. All this coming as it does so soon after the disastrous strike or lock-out in London, and the sectional strikes in many provincial centres, only emphasizes the trouble and adds "insult to injury."

Personally I have had no trouble with contracts which were in hand when the war started, and builders are doing their best to get on with them—and I do not anticipate any extras—but, I think it is only fair, if the job is genuinely proceeded with, that an extension of time should be allowed to the contractor and that the penalty clauses should not be too strictly adhered to, because of the great difficulty which is being experienced in obtaining some kinds of materials.

In the case of one large contract for which the tender was accepted before the war, but which the contractor would not proceed with owing to the causes mentioned above, the matter was settled and the contract signed upon my clients agreeing to pay an additional sum to cover the extra cost of materials attributable to the war used upon the work, over and above the prices prevailing at the date of the tender. Such extra sum in total is not to exceed five per cent. of the total cost of the job and is to be the subject matter of a separate certificate at the completion of the contract, upon ocular proof being demonstrated to me that the extra prices have been actually disbursed.

In small jobs I have not found that prices have been so materially affected as to make the carrying out of the work impossible or unremunerative. In many cases I am only too sorry to say (for unfortunately I sometimes have been guilty of it myself) when making out the preliminary estimates of the cost of the works to submit to one's client, sufficient notice has not been taken of the increasing stringency of Building Acts and By-Laws, and of the enormous advances in the price of labor and the cost of material, which, taken with the rise of insurance premiums for employers' liability, unemploymeit, health, and such burdens, all however very useful and necessary in their way, have in the last twenty years or so, in my opinion, raised the price of building work some forty per cent., and even in the last few years by as much as 15 to 20 per cent. Consequently the client has been given a false impression of what he would be called upon to pay, and been dissatisfied when the tenders arrived.

I think in a few months' time when timber ports are fully open again and either the old or new markets are available for the purchase of materials which have inordinately increased in price, that no difficulty will be experienced in building works, for already the cost of some materials which rapidly went up has dropped considerably.

Should, however, such optimism not be realized then it will surely be time for H. M. Government to step in and fix a maximum price for the respective materials (as has been done with success in the case of food), so as to prevent grasping merchants and importers from making an inordinate profit and crippling the industry of the country, thereby causing serious unemployment to the detriment of the community at large.

What is our good friend the Chancellor of the Exchequer, the Rt. Hon. D, Lloyd George doing? He very generously promised a sum of four million pounds to be spent at once in housing schemes. This could now be readily applied and would be an enormous help not only to the architects, who by the bye would only receive a very small part of it, but also to the workers in the building and allied trades. Moreover, it would supply that much needed provision of housing which is so abundantly required and which is so anxiously being begged for in all parts of the land. I recently saw a notice that housing schemes were to be sparingly prepared, but I cannot think that the promised sum has yet been earmarked or spent, and to my mind the sooner a start is made with it the better. Unfortunately the rate of interest charged by the Public Works Loan Commissioners has been raised from 3½ to 4 per cent., which, of course, will make a lot of difference in the preparation of housing schemes, and I am afraid in some cases will cause the houses either to be let at rents greater than the people can afford to pay so as to show an adequate return on the net outlay, or else the places must be let at an uneconomic rent and then the ratepayers at large must make up the deficiency, which is not a proper course to pursue. I sincerely hope it will be possible to keep the rate of interest down so as to enable the housing schemes to be proceeded with.

At our last Annual Dinner, Mr. Herbert Samuel, President of the Local Government Board, promised he would help architects and the building trade. I venture to submit that now is the time when it can be done with the greatest effect and most advantage to all concerned, and if by any means he can extract the money from the Treasury it would be a good act done.

A serious question is just being borne in upon contractors as to what is their responsibility in time of war should the buildings they are in charge of be damaged or destroyed by an enemy. Our Honorary Solicitor takes the view that in the event of a building, or addition to a building, in course of construction, being damaged by the King's enemies, where the contract provides for a fixed sum to be paid upon completion, the loss would fall upon the contractor, and not upon the employer, in the absence of express provision to the contrary.

In the event, however, of the contract providing for periodical payments against works performed, the contractor's claim for payment against works performed at the time of the loss would remain valid, and the loss to that extent would fall on the employer.

It appears to me, therefore, that the contractor and the employer must either take out a policy at Lloyds' or in an insurance office covering his risk or else trust to Providence. Personally, I think this latter would be sufficient cover because I have faith in our Navy. Of course, there is always a chance of bombs from aircraft, but the contingency, I need not submit, is very remote.

An Opportunity for the Professional Societies

Can architectural or other professional societies do anything to encourage the building industry? Could a representative Round Table Conference be called of all connected with the industry and its many branches—manufacturers, factors, contractors, building owners, architects, surveyors, engineers, government departments, and representatives of skilled trades connected therewith? This is a matter well worthy of our consideration, and I shall put it down as soon as possible upon one of our Agendas for discussion so as to obtain the views of the Council thereon before doing anything definite.

Unquestionably the war will have a detrimental effect upon architectural prospects. In many instances jobs have been held up which it was hoped would have been proceeded with, and in some cases for which tenders even had been received. This has been caused mainly, I take it, owing to the stringency of the money question, to banks stopping overdrafts and sometimes refusing to allow a man to withdraw his own money thereby causing much dislocation of trade as well as completely upsetting all usual monetary conditions. This condition, however, is improving every day, and shortly we may anticipate that things will become more normal.

One result of the war will, I think, be the impressing upon all concerned the necessity of the most rigid economy and reorganization of methods of building as well as the standardization of materials used, though not necessarily so as to make every street of houses appear as if they have been built from a box of bricks or even cast in the same mould. This monotonous effect when it is resorted to is always sure to be depressing and to give dissatisfaction, and what an architect has to aim at is greater elasticity and freedom in his design but not necessarily a searching after exaggerated effect which unfortunately very often produces monstrosities. It must be remembered that by pleasing the eye in the matter of building one undoubtedly improves the mind.

For the time being, owing to stringency of money matters, building contracts are sure to be held up and difficulties can only be dispelled by the close working together of all concerned, the rearrangement of methods in manufactory and workshop, and the strictest economy of architects and quantity surveyors, the latter in particular, in specifying the various articles and the manner in which they are to be employed. It is so easy to make a job come out at an excessive price by filling up the bill of quantities with innumerable labors and small works which could and should be priced in with the article itself. Only by such care being taken can the building owner be encouraged to proceed with new work by being made to feel that every consideration is being shown to him so as to give him the cheapest possible job compatible with good work. Then again the financiers who have been in the habit of taking up large contracts are not at present able to put their money into building works for the reasons I have before mentioned. But apart from the war, this standing aloof unfortunately has been the case for some considerable time for there is so little margin of profit, sometimes none at all, owing to the greatly increased cost of building, that the risk incurred is not commensurate with the chance of profit, and if building is to go forward it must either be by the reduction of the cost of the work (which is not possible below a given standard) or else when it is done the promoter must receive a greater return for his outlay. This can only be construed into more rent, and it comes to this that if the worker in whatever branch he may be is to earn or receive some profit for his work, then the people who pay must receive sufficient money to pay with, and thus the money question goes on in a never ending circle, and it stands to reason that if the cost of making a thing is raised it will cost more to hire or purchase.

The Society is conducting an enquiry into the discrepancies which exist between the cost of building in large foreign cities as compared with that in London; this, however, owing to the war, is held up at the present time, but so soon as something is ready for submission to the members I hope to get it out, as it will undoubtedly give some idea as to what can be done in the matter of standardization and reorganization of our methods.

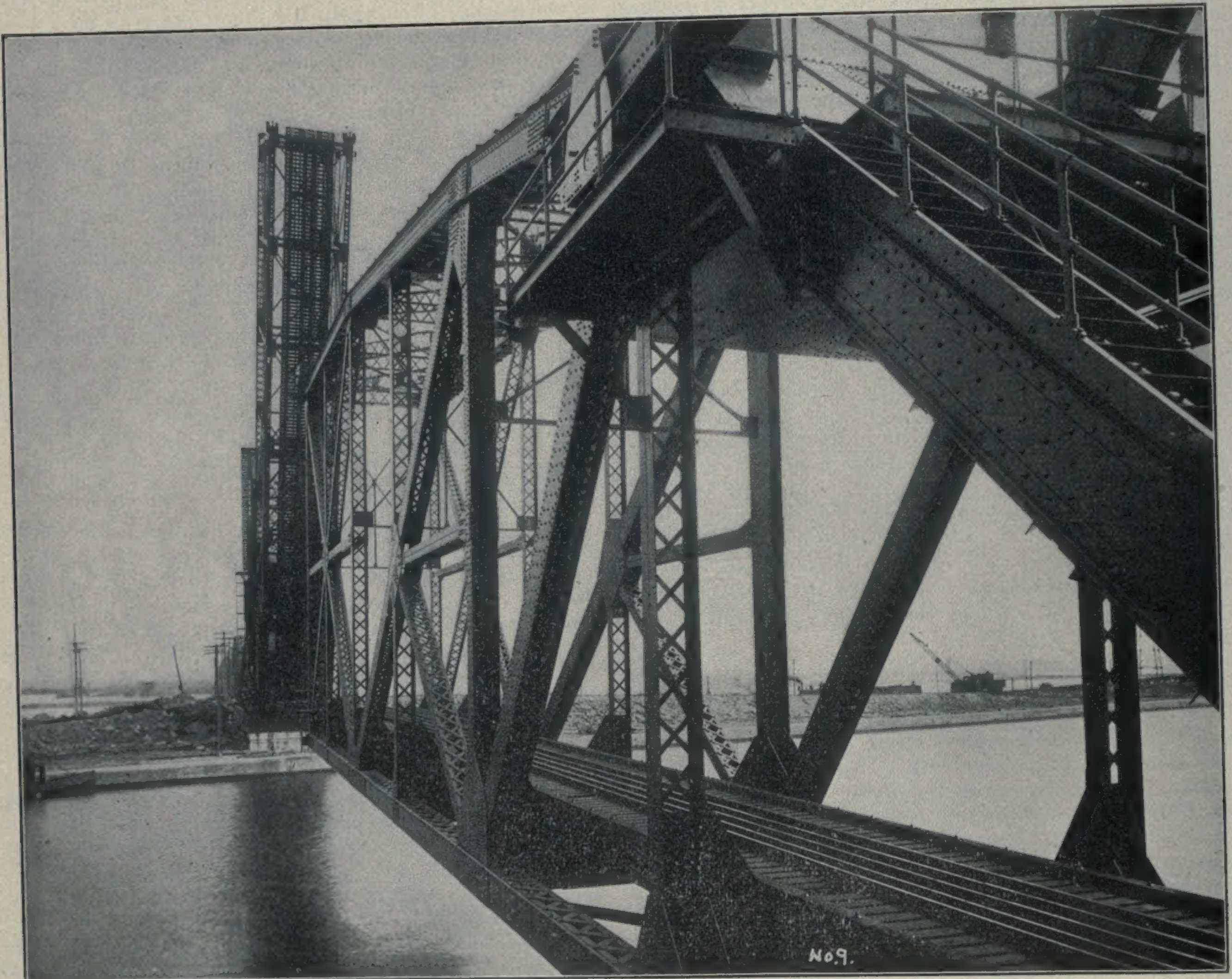
In addition to the stringency of the money proposition and the need of profit on schemes, there is the uncertainty as to the policy proposed to be meted out by the Government under the Land Question, and there has been a considerable slump in the investing of monies in this direction, and it has been difficult to negotiate sales and mortgages. Is it not possible for the Government through the Land Valuation Department to lend money on mortgage on well secured property up to, say, two-thirds of its value at a reasonable rate of interest to be paid back in a stated time? This would get over the difficulties which are now occasioned by the Banks feeling a diffidence on the subject and would, moreover, show that the powers that be were willing to help all classes of the community.

The famous time-ball at Greenwich is to be replaced by a new aluminium ball, its mechanism overhauled and reconstructed. The winch will be removed from its present position near the Octagon Room to the Ball Lobby. The time-ball was first erected in 1833. An electric current from the clock was first used to drop it at one o'clock in 1852. In 1855 the ball was blown down into the courtyard. Some repairs were made in 1895, when the chain broke during winding, and again, in August, 1913, some temporary repairs were made to the ball.

The New Bascule Bridge Which Connects the Two Sault Ste. Maries*

THE completion of the new Bascule bridge from Sault Ste. Marie, Ontario, to Sault Ste. Marie, Michigan, on the Canadian Pacific Railway marks a new record in bridge construction, as the structure is the largest of its kind in the world, being 330 feet in length, and containing several features peculiarly its own. The rapidity with which the work has been constructed has been such that its opening last September was really ahead of the time when it was expected to be ready for the operation of the railway adjoining Canada and the United States at this point. The design of the bridge chosen was that submitted by the Strauss Bascule-Bridge Company, of Chicago, Ill., and the work has been carried out by the Pennsylvania Steel Company, of Steelton, Pa.

The accompanying illustrations will give some idea of the magnitude, as well as the intricate details of the structure. The first view is taken from the operating tower, and shows the south leaf of the bridge closed with the north leaf in the open position. Each leaf is hinged on a steel tower, and is exactly counterbalanced on the opposite side of the tower. On the balancing structure there is a concrete block containing five hundred and fifty cubic yards of concrete, and weighing over one thousand tons. So exactly is each leaf of the bridge balanced with the outer counterweights that a very light power is necessary to be applied to raise the leaf and lower the counterweight, the one acting in equilibrium with the other.



New Bascule bridge between Sault Ste. Marie, Michigan, and Sault Ste. Marie, Ontario, on the Canadian Pacific Railway.

The second view shows a general view of the bridge with both leaves centrally locked in place. It should be mentioned in this connection that the south leaf arch tower rests on rollers, allowing a six-inch transverse or side-swing movement to the entire southern leaf in either direction. The operation of this movement when it may be necessary is accomplished by hydraulic cylinders, and a suitable hydraulic hand pump is arranged so that the operator can force the liquid under pressure on either side of the plunger, and so eventually move the entire tower and attached leaf in either direction, so that the two leaves speedily and

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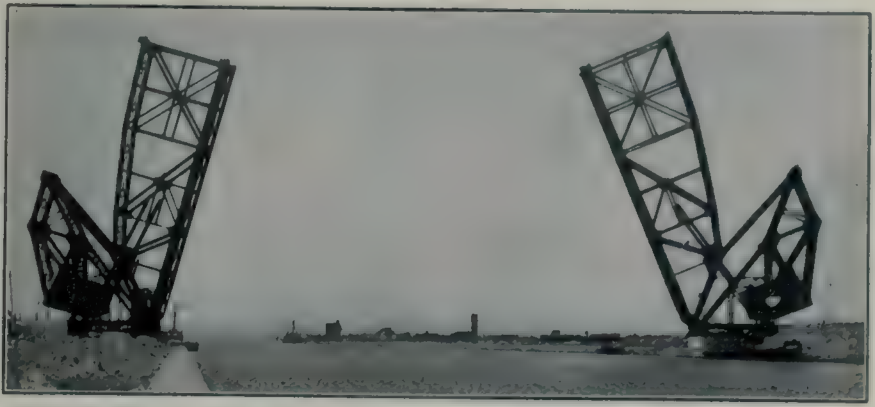
*From Railway and Locomotive Engineering, New York City.



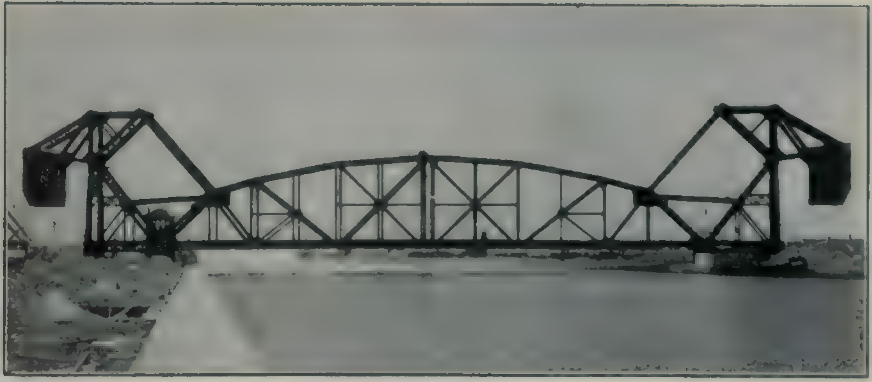
New Bascule bridge, Canadian Pacific Railway, with leaves fully opened.

exactly join in their necessary and perfect alignment.

The last illustration shows the bridge with the two leaves fully opened, and it may be added that while both leaves are opened to vessels of larger dimensions having deep draught, which consequently makes it necessary for them to keep in the centre of the channel. Vessels of lesser draught may safely pass through with one leaf open, but the opening or closing of both leaves of the great bridge is so easily accomplished, as we have already stated, that the expense of the movement is almost a negligible quantity, and only involves the light handling of an ordinary hydraulic jack. It may also be safely stated that as the balancing is so perfect, and the moving parts so massively and simply constructed, the possibility of any part of the structure getting out of order is reduced to a minimum.

The Canadian Pacific Railway is to be congratulated on the completion of the work, and we understand that others of this particular kind of structure are contemplated. It is not likely, however, that the others will be as large as the structure just finished. The tests have demonstrated the absolute rigidity and complete safety of the structure under weight many times more than will ever be placed upon it in actual service. While no expense has been spared in securing the best materials available, and the best workmanship under thorough inspectors, the manipulation of the vast structure is, as we have stated, exceedingly simple. One tower man is all that is necessary in handling the few mechanical appliances used in raising and lowering the leaves of the bridge.

More than $10,000,000 was spent on municipal work in Toronto last season according to a report presented by the Commissioner of Works, Mr. R. C. Harris. The following are details of this expenditure: roadways, $3,538,002.65; sewers, $2,972,481.74; water-works, $2,194,511.60; railways and bridges, $729,518.21; marine works, $26,264.17; miscellaneous, $1,445,405.77. During the year 89.90 miles of sewers were commenced and 60.7 miles have been completed. Forty-two miles of pavements and 54 miles of sidewalks have been laid. Five subways have been constructed in connection with the North Toronto grade separation. Twenty-six miles of water mains were laid, 22 street corners were rounded and 11 streets extended.



New Bascule bridge with leaves centrally located in place.

The Proposed Civic Centre for Vancouver

When the absolute need of a new city hall became impressed on the people of Vancouver about a year ago the Civic Centre idea came into being, a number of the leading citizens recognizing that the opportunity was at hand to do something really worth while in the way of town planning. The result was the formation of the City Beautiful Association, or the Vancouver Planning and Beautifying Association, as it is now designated, which nominated a Civic Centre committee and invited the various public bodies to appoint representatives thereon. Mr. J. N. Banfield was made Chairman of the Joint Committee, while Mr. G. R. G. Conway, Chief Engineer of the British Columbia Electric Railway, was induced to become head of the Plans Committee, on which a very large share of the subsequent work has fallen.

By general consent the project was considered in a broad spirit, it being recognized that to limit the projected improvement scheme to a few blocks only would impair both the architectural and financial success of the scheme. It was decided, therefore, to include the old court-house site, the Central School site, the old Hospital site and recreation grounds, as well as part or the whole of the remainder of the private property extending from Pender to Robson streets and from Beatty to Homer streets, provision to be made in the plans for a city hall, a public library, a technical college, a museum and art gallery, and a public hall or auditorium, as well as ample ground space for other semi-public buildings which may be erected later on, the whole area to include eight or nine blocks.

In July last the Civic Centre Committee asked the City Council for a grant of $1,500 to enable it to offer prizes for suitable designs. The request was turned down, whereupon Mr. Wm. Farrell, Managing Director of the B. C. Telephone Company, came to the rescue by donating the entire amount. It was decided to offer half the sum in prizes and retain the balance as a fund from which to defray other incidental expenses, including a deputation to Victoria to urge an amendment to the Municipal Act giving the city the power to expropriate land and properties and to control the height and building line of erections in the vicinity of the area to be reserved.

The widespread interest taken in the Civic Centre project is indicated in the fact that no fewer than thirty-seven competitors sent in plans. The choice of a competent and unbiased assessor became necessary, and on the recommendation of Hon. Clifford Sifton, Chairman of the Canadian Commission of Conservation, Mr. Thomas Adams, Town Planning Adviser to the Commission, was appointed. Mr. Adams visited Vancouver recently, and after carefully considering the merits of each plan, on December 18th awarded the $500 prize for the best design to **Messrs. Theodore Kerner and Robert Mattocks**, draughtsmen for T. H. Mawson & Sons, Vancouver; the second prize of $250 going to **Mr. Fred L. Townley**, of the city draughting department. The other competitors were: S. Warwick, Montreal; Thos. Hooper, Vancouver; E. P. Cumming, Vancouver; J. M. Warren, Victoria; Bryan & Gillam, Vancouver; J. H. H. Davies, Regina; J. A. Garratt, Seattle; G. L. Wright, Vancouver; H. A. Stone, Vancouver; J. W. Keagy and R. McKay Fripp, Vancouver; E. Babcock, Vancouver; Wm. Dalzell, Montreal; R. McKay Fripp, Vancouver; Thos. Hawks, Vancouver; W. T. Whiteway, Vancouver; Wilson & Wilson, Vancouver; H. L. Copeland, Olympia, Wash.; Honeyman & Curtis, Vancouver; Doctor, Stewart & Davie, Vancouver; D. P. Rixford, Victoria; Geo. Johanson, Kamloops; J. S. Helyer, Vancouver; Bryan & Gillam, Vancouver; H. G. Stone, Vancouver; Jas. McLaren, Vancouver; R. Lyon, Vancouver; T. E. Julian, Vancouver; A. N. Knox, Vancouver; S. B. Birds, Vancouver; J. H. Curzon, Toronto; A. E. Henderson, Vancouver; A. Paine, South Vancouver; J. E. Gerrard, Kerrisdale.

The area included in the scheme of Messrs. Kerner and Mattocks is a somewhat irregular quadrilateral bounded by Pender, Beatty, Georgia and Hamilton streets, and taking in, in addition, the old court house site between Hastings and Pender streets. The main axis of the civic centre runs south along Cambie street to Georgia from the point where Pender and Cambie intersect. The secondary axis lies along Dunsmuir street. The plan is to close Cambie street between Pender and Georgia and to open from the intersection of Pender and Cambie two new diagonal streets, the one running southeast to the intersection of Dunsmuir and Beatty, the other southwest through the Central School grounds to the intersection of Dunsmuir and Hamilton. The old court-house site is laid out as a town garden, with a fountain in the centre and walks, flowers, grass plots and shrubbery. At the Hastings street end is a car shelter on the street level, with a comfort station beneath.

Another town garden, laid out on much the same lines as the above, occupies the apex of the triangle formed by the two new diagonal streets. Directly south of the second garden, and occupying all the remainder of the space between the new streets and Dunsmuir street is the City Hall site, fronting which across Dunsmuir street is a large public square. The suggestion is made that the scheme be carried out in three sections.

To the east of the public square, on a portion of the present recreation grounds, is the site for the Technical School, and to the west the site of a Museum and Art Gallery. Beyond these buildings is space for four semi-public buildings. These, it is suggested, may be erected as the growth of the city demands. Coming north again to Pender street, the plan suggests a Public Library in the triangular space at the corner of Pender and Hamilton, just south of the old court-house site; and an Auditorium and Public Hall in the triangle made by Pender, Beatty and the most easterly of the new diagonal streets.

The Proposed Shipbuilding Plant at North Vancouver

The shipbuilding plant which is to be erected at North Vancouver, B.C., by the Dominion Shipbuilding & Drydock Company, Limited, is to cost $5,000,000. The site extends over 140 acres.

The first unit of the works is now under construction, while the plans for the second unit are at Ottawa, awaiting the approval of the authorities. The whole project is scheduled for completion in two and one-half years.

Of the total expenditure mentioned above, the graving dock, with pumping plant, is to cost $1,500,000. A Western correspondent advises us that a prospectus giving all information on building and machinery required may be obtained on application to the Dominion Shipbuilding and Drydock Company, Limited, 14 Canada Life Building, Vancouver. The President and Managing Director of this firm is Capt. Harry Mowatt, and the Vice-President Mr. Robt. Fowley. The Company's Solicitors are Messrs. Taylor, Harvey, Grant, Stockton & Smith, 413 Granville Street, Vancouver.

The Architect's Wife: A Study of Difficulties

(From the London Builder)

THERE are few more difficult roles to play in the drama of life than that of an architect's wife, for she must be gifted by nature with a dual personality, or else be a consummate actress and one who can instantaneously play a part when necessity demands. Being a woman, she knows that no man can design a house without making grave mistakes, for is not a woman's intuition of more value than any man's knowledge where the details of a house are concerned? On the other hand, has she not promised to love, honor, and —— her husband—that is, a man whose judgment she knows is at fault in matters which only a woman can speak authoritatively about? The result is that there are two warring elements at work, neither of which can be consistently satisfied.

If, as is sometimes the case, her husband's clients are her personal friends, she is in a quandary, for she sees the defects of his work, but must in loyalty to him conceal her knowledge till she can have a tete-a-tete with him. Her eloquence is checked because she cannot give free play to her understanding; she is, in fact, in the position of counsel defending a criminal of whose guilt he is assured, and, being a woman, her sense of justice is not satisfied with the consolation that she is but following time-honored precedent, which is sufficient for a mere man and husband. The difficulties of an architect in his attempt to secure his ends by the means of a number of imperfect agencies such as the work of builders and workmen do not as a rule appeal to a temperament which is idealistic and thorough to an extent that man seldom understands. Ultimate perfection seems to her attainable, and any defects which occur through defective oversight or want of judgment are dismissed as things which should have been obviated. No woman really thinks that to err is human, and, though in large matters her forgiveness may be divine, she is often unwilling to exercise it in the trivial affairs of life, perhaps thinking by so doing she is throwing pearls before swine. Every woman for whom an architect builds finds defects in the house which has been completed, and the architect's wife finds her natural sympathy with her own sex and her womanly esprit de corps in conflict with her position as the wife of the offender. If the architect's work is of a public character his difficulty largely disappears, for his wife will admit that he is more likely to know the requirements of a public building than she is; nor will she be placed in the same personal contact with the employers, as is often the case with a house.

Is there any way to avoid the grave dilemmas which we have indicated and to save the architect's wife from the difficulties which we have briefly described? The most ideal plan is, as it usually is in life, the least practicable one—that the architect should keep his profession a secret from his wife. If he could get through life described as being "something in the City" the difficulty would vanish, but in most cases this would be impracticable, and the architect has to stand in the dock from the outset. Or if, on the other hand, all his work lies at a distance from his dwelling-place, and his clients are unknown to his wife, he will be able to conceal his defects from sight; but this, again, is not always practicable. In the third case, he may try to obtain some of the advantages of collective action by securing his wife's criticism of and acquiescence in his designs before they are executed; but this method has the disadvantage that the architect's wife is burdened with the responsibilities of her husband's business as well as her own affairs.

We have but shortly explained some of the difficulties of a position which we have often felt sympathy with, and there seems to be only two solutions, namely, that if a man elect to follow architecture as a calling he should not marry, or, if he looks forward to marriage, he should not elect to be an architect, as if he does both he places the lady of his choice in a position the difficulties of which are exceptional. But women are nothing if not self-sacrificing and heroic, and, difficult as the position is, many acquit themselves as only women can, and it certainly is true that no woman is so worthy of canonisation as she who adequately fills the difficult role of the architect's wife, for she can be classed with the camel who passes through the eye of a needle or the Chancellor of the Exchequer who produces a Budget which pleases every class of the community, convincing them that it is more blessed to give than to receive.

The Way of Success

Success is not the offspring of a miracle. Concentrated thought closely allied with determination is the secret of success. However, do not for one moment think that because determination is mentioned as an ally it is a secondary feature. It is most important. All the concentrated thought available would not bring about success unless determination was there, and very much there. Anything desirable is obtainable, provided that you have sufficient determination to go out and get it.

This is an era of fierce competition, and if you want anything, no matter what, you have to get out and do battle for it, with the feeling that you must and will have it. You deserve no more than you get, for the very simple reason that you usually get what you determine to have. Therefore what you lack is lacking because you don't want it sufficiently to get out and strive for it. The amount it becomes absolutely necessary to your life or happiness you will get it.

A diamond mine is a diamond mine, but what good is it until the stones are taken out and put into shape to sell?

The human being is a good deal like a diamond mine, full of possibilities, but raw and undeveloped, and, like the diamond, your thoughts are useless until polished and ready to market.

These thoughts are the requirements necessary for success, but as long as they lie buried or the diamonds remain unmined neither will be of any use to either their owners or any one else.

If you want anything on this earth you must dig, and use as your spade the sharpest and best tempered tools, and keep on digging until you accomplish your purpose. No doubt there will be a few aches and pains, and at times you will be mighty tired, but by keeping everlastingly at it you will strike that "pay dirt" called success. You may have the diamond mine and the thought tools, but they will be of no use to you unless you "dig." Suppose you start in now and jam the first spade home to-day. Then keep at it until the good things come.

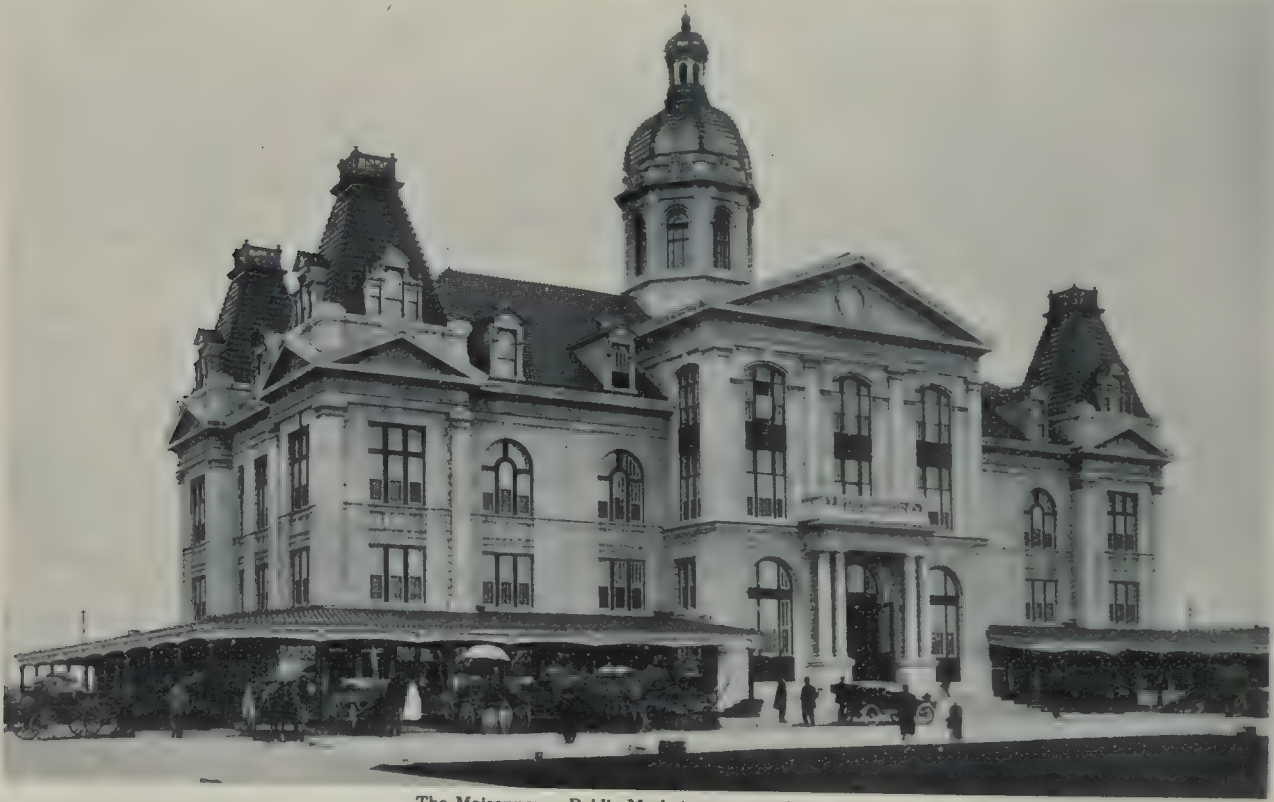
The Maisonneuve Public Market: Its Construction and Equipment

By R Percy Sims

MAISONNEUVE, a suburb of Montreal, in spite of its comparative youth as a city, is generally recognized as one of the most progressive and well-managed municipalities in North America.

The object of this article is to give a general description of the Public Market, which has recently been established and put into operation.

Standing in the centre of a large open space, which measures 500 feet by 390 feet, the market shows to great advantage, and is distinctly a credit to the city and its designer. The open space is surrounded with wide concrete walks and roadways, interspaced with grass. In the centre of the space, in front of the Market Building, is an ornamental fountain, of charming design.



The Maisonneuve Public Market upon completion.

The whole arrangement, including the Market and its entire equipment (with the exception of the Mechanical Refrigeration Equipment) is from the designs and detailed specifications of Mr. Marius Dufresne, the City Engineer and Architect, and is one of the most complete of its kind. The total cost has slightly exceeded $300,000.

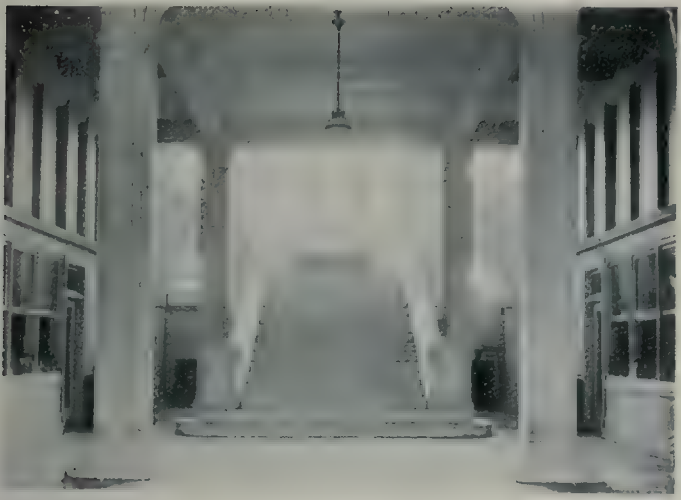
The Market Building is of Montreal limestone, the basement being of concrete. The roof is covered with Spanish tile, the centre being surmounted by a large glass cupola tower. The area of the Market Building is 25,000 square feet, the frontage measuring about 200 feet. The height of the top of the cupola tower above the level of the roadway is about 112 feet.

On the outside of the building, under a wide lean-to roof, or marquise, which is also covered with Spanish tile, are the Stalls, twenty in number, for the fruit, garden truck and fish dealers. The floor areas of these outside Stalls vary from 160 square feet to 183 square feet. Each outside Stall has a separate store room in the basement, which is provided with ample storage facilities, and with a private entrance from the Stall.

There are four entrances to the building, the main entrance facing the ornamental fountain; there is one entrance at the rear of the building, and the other two are at the ends of the main corridor, from whch one gets an excellent view of the Market Floor. The main entrance is approached by wide stone steps. Immediately inside the brass screen doors are situated the office of the Market Clerk, on one side, and the Board Room of the Market Committee on the other. Directly opposite the main entrance, across the main corridor, is the staircase leading to the upper floor of the Market.

The ceiling of the Market Floor is high, and each vaulted panel contains an electric light. The floor is of polished terrazzo, and all the corners are rounded to provide for easy cleaning and to prevent the accumulation of dirt. The main Corridor is 15 feet wide, and divides the Market Floor from end to end.

Facing the main corridor are sixteen stalls, used



Main Stairway.

Main Corridor.

by butchers and grocers, eight on each side. These stalls are complete stores in themselves, the area of each varying from 161 square feet to 339 square feet. Each is provided with an up-to-date Cold Room, an Office, Counters, collapsible steel gate, etc. The appearance of each stall is very attractive, the woodwork being of dark oak, the counter tops being of white marble. The collapsible steel gates are of ornamental design and can be easily drawn across the front of each Stall, and locked, giving perfect security when required.

Every stall-holder is provided with an abundant supply of hot and cold water, heat, light, refrigeration of the Cold Room, and ice for packing and other purposes, all of which are furnished at approximate cost and included in the rental charge.

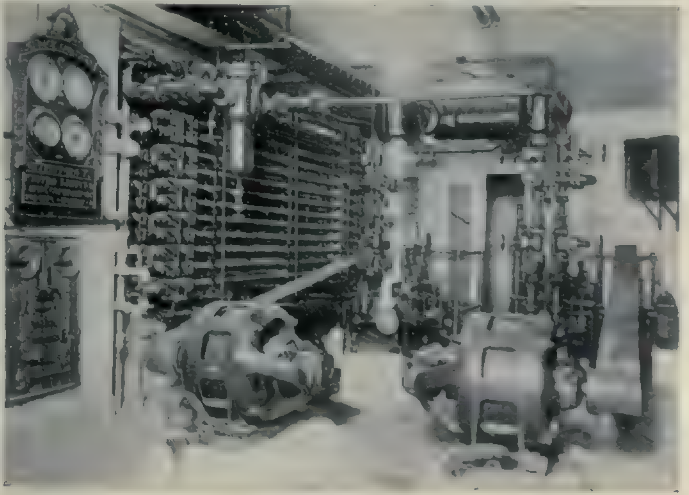
The upper floor of the Market is without partitions of any kind, and it is intended to use it as a hall for Pure Food Exhibits, small farmers' display tables, and other purposes having to do with the solution of the problem of bringing the producer and consumer of food products into closer alliance and better understanding.

In the basement of the Market, in addition to the store-rooms for the use of certain stall-holders, there are rooms specially arranged for the machinery necessary for the efficient operation of a modern Public Market. This machinery is used for pumping water, heating, ice making and refrigerating. All the machinery is operated by electricity, thus eliminating smoke, coal dust and other nuisances incidental to power plants, and preserving the clean fresh sanitary conditions of the entire building. In the case of the heating apparatus, the steam is conveyed underground from another municipal building. It is the "Presto" system that has been adopted, and the results have been very satisfactory.

To secure an abundant supply of water, so necessary in a Public Market, an artesian well has been sunk. The clear cold water from this source is raised by means of an air lift into a 20,000-gallon tank in the tower. From this tank the water is distributed by gravity throughout the building. An electrically driven air compressor, with the usual air-storage tanks, comprises the pumping equipment. City water mains also connect with the water distributing system, thus furnishing an alternative and emergency supply in the event of the failure of the Market plant.

One of the most interesting—and at the same time essential—features of the equipment of a modern and efficient Public Market is the Mechanical Refrigerating Plant. The writer of this article was invited to prepare the necessary Drawings and Specifications for this part of the Market equipment. The following details may be found interesting. The system adopted for the refrigeration of the Cold Rooms is that known as the "Brine Circulating System," by which brine of low temperature is circulated continuously, by means

Hall on Second Floor.



Refrigerating Machinery Room.

of pumps, through a series of coils in each Cold Room. In the Maisonneuve Public Market, these coils are galvanized and are fixed to the back wall of each room, practically covering the whole face. Under each coil is a galvanized drip-tray, for the collection of drip caused by the melting of the frost on the pipes, should the temperature of the room rise above 32 deg. Fahrenheit. Each tenant is provided with a globe valve, so that he can regulate, within certain limits, the temperature of his room. In addition to the tenant's valve, there is a "master valve" on each delivery pipe to, and each return pipe from, each room. The object of these master valves is to allow the Market authorities to cut off the supply to any one or more Cold Rooms, should the necessity arise. These master valves are locked, the key being in the care of the Market Clerk.

The Cold Rooms are constructed on the most modern and sanitary principles, and are much appreciated by the tenants of the Market. The floors, ceilings and walls are insulated by compressed corkboard, made by The Robinson Cork Company, of Port Colborne. This corkboard is erected in two layers, each 2 ins. thick. The facing of the ceilings and walls is of Portland cement with a hard glazed enamel finish. The covering of the corkboard on the floors is of concrete, with a Portland cement float finish. Each Cold Room is provided with door, and a triple-glass show window, the larger rooms having two windows. All metal work, such as meat rails, hooks, etc., is galvanized.

An Inside Corner Stall.

The Machinery Room is situated in the basement of the Market, and contains two "Frick" horizontal, belt-driven Ammonia Compressors, each having a nominal refrigerating capacity equal to the melting of ten tons of ice per day of 24 hours. Each compressor is driven by a Crocker-Wheeler electric motor, of the slip-ring type, capable of developing 20 brake-horse power. Double-pipe ammonia Condensers, a liquid-ammonia Receiver, Oil Separator, Oil Filter and the ornamental Gauge-Board complete the refrigerating apparatus in this room. For the lubricating oil used on the machinery, a Bowser filtering system has been installed. The oil, after having passed through the bearings, is drained into a sump, from which it is lifted, by means of a small water-driven pump, to the filter-reservoir, which is placed as high up on the wall as possible. From here it gravitates, through brass pipes, to all bearings. By filtering the lubricating oil, it can be used over and over again, this resulting in considerable economy.

The Ice-making Room is also situated in the basement, directly opposite the Machinery Room, across the corridor. This room contains the Brine Tank and the Brine Circulating Pumps. The Tank performs the double duty of refrigerating the Brine for the Cold Rooms and the manufacture of ice. It is 14 ft. long by 8 ft. wide and 3 ft. 8 ins. deep, and is efficiently insulated with corkboard to prevent any undue radiation. Immersed in the brine are five oval, vertical, galvanized coils, made of 1¼-in. extra heavy pipe, each wound in one continuous length. These coils are used for the expansion into gas of the liquid ammonia, this evaporation causing a reduction in the temperature of the surrounding brine. Between each vertical coil the ice-cans are placed. The latter measure 4 ins. wide by 16 ins. long and 31 ins. deep. There are fifty-four ice-cans in the tank, each making 50 lbs. of ice in seven hours. The brine is circulated through these cans by the return main from the cold rooms being connected to a 3-in. header at the top, and across one end of the tank. The brine delivery for the cold rooms is taken from another 3-in. header across the other end, but at the bottom of the tank. Both headers are perforated with a line of ½-in. holes. This simple method distributes the brine evenly throughout the tank. The connections to the brine-circulating pumps have been arranged so that this circulation is maintained even if the supply to all the Cold Rooms has been cut off. An automatic can-filler is provided for the rapid and accurate filling of the cans with the water to be frozen. A small brine-mixing tank is also provided, so that the chloride of calcium needed, from time to time, to increase the density of the brine in the ice-making tank, can be properly dissolved before it is delivered to the ice-making tank. The brine is circulated throughout the system by duplicate Deming Triplex Pumps, geared direct to 5 h.p. electric motors.

As so much depends on the continuance of the refrigerating service in an establishment of this kind, it was decided to duplicate all the important parts of the equipment, such as the ammonia compressors, electric motors, pumps, etc. In addition, more space can be refrigerated, should such be required in the future.

The contract for the refrigerating equipment was let to Messrs. Keiths, Limited, of Toronto and Montreal, who are the Canadian representatives of Messrs. The Frick Company, of Waynesboro, Pennsylvania.

A report issued by the Austrian Society of Engineers and Architects gives the results of an investigation conducted by the Committee on Reinforced Concrete. It is pointed out that questions for consideration by the designer are the degree of fixity to be allowed for in the calculation of bending moments and in the design of reinforcement for resistance to negative bending moments. While the ends of reinforced concrete beams as usually applied are supposed to be fixed, the condition of perfect fixity is rarely attained. One of the most remarkable points brought out in the course of the investigation is the fact that the resistance of beams stiffened by gussets or knee braces at the ends is seven times greater than that of beams uniform in cross-section throughout.

The Application of Business Methods to Constructional Undertakings

By James L. Stuart, Contracting Engineer, Pittsburgh, Pa.

(Abstract of a Paper and Discussion before the Cleveland Engineering Society)

PERHAPS there is no business which responds more quickly to what is termed "business methods" than does the average piece of construction work. Certainly there is no business with more diversified interests and trades connected with it than the modern structure, be it railroad terminal, factory, office building, hospital, or hotel.

It has not been more than 20 years, at most, since the construction of buildings was left entirely to practical men who had themselves worked up from positions as artisans or laborers to positions of leadership in constructional lines. Some of these leaders in the past were most talented and even brilliant; but they did not bring with them into the business, except in rare instances, the methods of the trained engineer or the progressive business man, their principal assets being nervous force, excessive ability, and practical knowledge of the building trades. However, as building construction became more complex and of greater magnitude, the necessity of trained men who understood the engineering problems, and who appreciated the application of business methods necessary to bring "order out of chaos," became more apparent; and now both engineering knowledge and modern business methods are most necessary to get proper results as to economy and quailty in all of the larger undertakings.

Methods and Organization.—In order to construct a building successfully, it is necessary that one should anticipate each step in the progress of its developments and outline a complete system for its erection, including the various steps from the time the drawings are received from the engineer or architect until the building is turned over completed to its owner. The first step in such a process is to make a complete estimate of the cost of the structure from the drawings and specifications, including every item mentioned in the specifications or shown on the drawings. In addition to this, there are other small items which are not mentioned in the specifications, but which are necessarily a part of the cost of the building and should be included as such. Under the latter are such items as the cost of administration, liability insurance, temporary buildings, expediting, tools and machinery, and numerous smaller items. These estimates of cost were originally made up by the contractors themselves, and were but approximations as compared with the present method of compiling them. In the latter method, every advantage is taken of the prevailing market prices when the estimate is made, of the conditions of the labor market, the physical condition under which the work is to be done, and the season of the year. In a properly prepared estimate, the unit-prices should vary on each individual piece of work, whether figured at the same time or not.

After the estimate has been made of the total cost of the building—and I think an estimate should be made of every building whether the work is to be let on a lump-sum contract, cost-plus-a-fixed-sum, or on a time and material basis—the next step is to make up a time schedule, allowing fixed periods of time for the completion of each part of the building. This must be done most carefully, as on this schedule are based the dates for completion of the different contracts for material, and for the contracts with sub-contractors for furnishing such portions of the work as are not to be executed by the general contractor's force in the field. This time schedule is made after a thorough study of the drawings, the site of the new project, and a familiarity with the estimate, which, as I have said before, gives the quantities of the different kinds of material and assets in estimating the length of time required to complete the various stages of the work.

After the estimate and the time schedule are completed and the contracts for material and labor have been entered into, the real work begins.

A dozen or more sets of drawings are procured from the architect or engineer, a copy of same placed on file in the main office of the builder, one copy sent to the job office, and the others distributed among various sub-contractors who have to make up their shop drawings and prepare certain materials to be later installed in the building. A careful record must be kept of these drawings, and to whom they are addressed and the date on which they are sent. While the various departments of the main office keep thoroughly in touch with the work in the field, and the material in preparation, at this point, if the work is of sufficient magnitude, it is turned over to one particular member of the contractor's force, preferably a trained engineer, whose duty it is to keep in thorough and constant touch with all the drawings and all of the correspondence. He also has access to the files of the sub-contractors, contracts, contracts for materials, the original estimate, and all other information pertaining to that particular piece of work. It is then his duty to follow up their shop drawings, the submitting of the same to the architect for approval, the ordering of materials by the sub-contractors, and the progress being made through the fabricating shops and mills. This following-up process is part of his daily routine; and from time to time reports are made to the superintendent in charge of the actual field work to enable him to know when the material is to be received, when the sub-contractors will have their men and material on the job, all of which enables him to shape up the field work so that certain portions of the building will be ready for certain sub-contractors at a fixed time. It is also his duty to keep track of the change orders and the changes made in the construction of the building, whether it be an addition or a subtraction. You can readily understand how necessary it is that all sub-contractors should be advised of changes, for often when they are conceived in the mind of the owner, their interference will be more far-reaching than he or anyone else anticipated.

A proper executive organization to do the field work is most important. It is far better to have too much assistance in the field than too little. First, there must be a superintendent who possesses rare abilities as an executive, who understands drawings and specifications thoroughly, who has had wide experience in building work, and who has a knowledge of the different trades so as to be able to anticipate far in advance of his requirements. Above all, he should be able to create in those working under him, including the workmen employed by his department, and foremen and workmen of the different sub-contractors, an enthusiasm in their work, a desire to see it grow steadily, and to do it in the most substantial manner possible. If the work is of sufficient magnitude, he should have an assistant superintendent, or possibly two or three of them, a large enough clerical force to do the timekeeping and to keep an accurate cost record; and he should segregate the cost of the additional work which was not originally provided for: All of this work, if permitted to lag for even a day, becomes most complicated; and, if not accurate, its value is entirely destroyed. In addition to this, it is the duty of one of the clerks to send to the main office each day an accurate and concise report of what has been done during the day, the state of the weather, temperature, etc. As the building nears completion, work in the main office lessens; and it is usually an excellent idea to have the man in charge of the particular job in the main office get in actual touch with the building and assist the superintendent in picking up the loose ends and in getting each trade completed as rapidly as the progress at the building will permit. This man (from the main office) is thoroughly familiar with each trade, knows just what changes have been made in the work, has a splendid knowledge as to how long it will take each trade to complete its work, knows the difficulties under which each has been laboring, and can finish his "following-up process" from the field more intelligently than if he were to remain at the main office.

Cost.—The cost of a piece of work is always of interest. The estimating department has access to the daily and weekly cost reports which are compiled in the accounting department; and from these they can compare and report to the proper person whether or not the work is being done each day or each week within the amount allowed for the same in the original estimate. If the work is not being done within this cost, and if the unit prices vary considerably from day to day, an investigation is at once made at the building to ascertain the reason for such fluctuations, to advise the superintendent of the discrepancy, and to see if ways and means cannot be found to bring the cost within its proper allowance—the estimate having been based on the cost of similar work under the same conditions. The proper average should not vary greatly from the amount allowed in the estimate.

The two following examples serve to illustrate the methods which were used in connection with the erection of a large manufacturing plant and a modern hotel building:

Construction of Large Plant near Pittsburgh.—Some time during the latter part of May, 1910, the manufacturing plant just referred to, covering approximately 15 acres, was almost totally destroyed by fire. All of the buildings were brick, some with wooden trusses and slate roofs, but the greater number were constructed with steel frames and cement tile roofs. The fire in and around these steel structures was so intense, however, that most of them collapsed, of their own weight, and were only a mass of twisted steel, broken cement tile, brick, and mortar, all of which it became necessary to remove in order to reconstruct the plant. We first received orders to clear the site, and subsequently were instructed to proceed with the reconstruction of the buildings. Fortunately, the power plant had not been greatly damaged, and, as a large portion of the plant had been electrically driven, we were able to get sufficient current of high voltage to use in cutting up, or, I should say, burning apart the collapsed steel frame. all of which was so badly damaged that it was loaded on cars and sold as junk.

After the site was cleared, we began excavating for the new foundations, starting on the buildings which would be required first and those in which the greatest amount of machinery was to be installed. This scheme was followed so as to enable the entire plant to be completed at about the same time. It was the desire of the manufacturing company to commence manufacturing about the first of October, or earlier if possible. The key to this particular situation was to get the steel, of which there were about 4,800 tons.

After consultation with the operating and executive departments of the manufacturing company, the order in which the different buildings were to be completed was decided on, and the dates were fixed for the delivery of the steel for each building, and were included in the schedule for the complete buildings. The structures were quite simple, similar to most of the modern factory buildings; but in order to live up to our schedule, we knew we must keep continually in touch with the bridge company, and see that nothing was permitted to lag or be left undone in order to make the deliveries as they promised. Our "expediter" was put in charge of the job at once, and, during the first month, spent most of his time between the order department of the bridge company and the steel mills where the plain material was being rolled. After the last of the orders for the plain material had been sent to the rolling mills, he devoted his time more particularly to the drawing room of the bridge company, and reported daily just what progress was being made in designing, detailing, and checking, the number of draftsmen employed, and the progress made on each building. At times it was found that the checking department was overbalanced by the detailing department, and that the designing department was not turning out sufficient work to keep the detailers and the checkers busy. This was adjusted by numerous meetings between the bridge company, the executive department, the manufacturing company, and ourselves.

I might say, at this point, that the principal requisites of an expediter are a thorough knowledge of the work to be performed, a pleasant personality, and the ability to interest the people who are actually doing the work—in this case, the men who made out the mill orders, the draftsmen, the different foremen in charge of the rolling mill, and the foremen in the fabricating shop. All should be made to feel that their interests are parallel and that what is good for one is good for all.

As soon as the drawings for one of the buildings were completed, we saw that this work was put in the shop at once, where someone had already attended to the delivery of the plain material, and that no time was lost in fabricating and shipping the same.

At times during the preparation of the drawings, it was found necessary to urge the bridge company to employ additional men in all departments. This required considerable tact and force as, naturally, the heads of the different departments do not care to have their routine changed or, as they express it, "meddled with." This phase of the difficulty can be overcome only when it is possible to arouse sufficient interest in that particular piece of work. When the work was started, our expediter received from the rolling mill, from which he knew the steel was to be furnished, a list of their daily rollings, and we saw to it that certain materials were gotten in on the dates at which the first rolling of that particular material was made. This saved considerable time, and we were able to get all of the plain material delivered before the shop drawings were entirely completed on the first building. The meetings between the heads of our department and the heads of the bridge company were most useful. Our expediter was usually on hand, and we were able to discuss the progress made since the last meeting, the condition of the work in the drafting room and in the shop, and to devise ways and means for overcoming any obstacles which had arisen, due either to lack of men or to want of materials.

The steel was erected as fast as the work was gotten out of the mill, fabricated, and delivered. We insisted on its being fabricated in sequence so that any materials delivered at the building could be immediately put in place. It had been previously decided at which end of the building the work would commence, and our superintendent in the field was advised of this fact and was also kept in thorough touch with the progress of the different stages of the steel. As the cars of steel were loaded and shipped out, they were put in the hands of the tracing department of the manufacturing company, and our own tracing department as well, and shipments were followed up until they were finally landed at the site. Our tracing department had, prior to this time, made the acquaintance of the different employees of the railroad through whom the records of the movement of the cars were to pass, as well as those who had direct charge at the transfer points. After the steel had been delivered, the rest of the work was a mere question of brick, mortar, sand, gravel, cement, window frames, sash, roofing material, and sufficient workmen. Of course, there were large quantities of all these materials required; and in order not to delay the work, it was imperative that certain amounts of the same be delivered and put in place prior to the delivery of the steel.

Construction of a Large Hotel in Cleveland.—The same general method was applied to the construction of the Statler Hotel, except that the work was much more complicated and required many more details. There were approximately 90 sub-contractors and material men in and around the building from almost the day it was started until its completion; and it required a great deal of patience, perseverance, and hard work to get the different trades to dovetail into one another throughout, so that those who did the preparatory work would finish and leave in time to permit the finished material to be erected in a proper and substantial manner. On the Statler Hotel we found it necessary from about the first of June until a few days before the building was turned over to Mr. Statler, to insist on daily meetings of all of the sub-contractors on the work, together with the architect's representative and others interested in the building. At these daily meetings, each trade was taken up separately with the principal representative of that particular trade and the representatives of all the other trades present. He was questioned regarding the progress of this work, and was told to state whether or not he was being retarded by any of the other trades. If it was found that his work was being hampered, he was made to state explicitly and in detail to what extent and how.

The advantage of having all of the sub-contractors together at one time can readily be seen, as it eliminated innumerable quarrels between the foremen of the different trades, and many misunderstandings which invariably arise due to the fact that the workmen and foremen are not always capable of expressing their troubles in an intelligent manner and, when they are busy, many times do not take the trouble to express themselves at all. It was rather hard to get them to continually attend these daily meetings, as they were held in the evening after they were supposed to be through with their work. We always tried to make the meetings as pleasant and as short as possible, and never permitted ill-feeling to exist between the several trades arising from the discussions at the meetings. A typewritten report of each meeting was posted on the general bulletin board so that each of the sub-contractors would have access to the same during the following day.

Lump-Sum or Percentage Basis for Contracts.—If we can get contracts under reasonable competition, we much prefer to do work on the lump-sum basis, as the work is then entirely in our hands, and whatever we can save by any unusual attention or ingenuity is ours. However, if there is a chance that the competition will not be fair, and we are after the job pretty hard, we are glad to take it on a commission basis. A great deal depends on conditions. If the contractor is thoroughly honest—and when I say "thoroughly honest" I mean if he has real conscience—then it seems to me that a commission basis is the best on which to operate from the standpoint of the owner, because he gets exactly that for which he pays.

When we take work on a commission basis—and we do a great deal of that work in Pittsburgh—we make up an estimate of the actual cost of the work, and tell the owner how much he is likely to expend. We do this for two reasons: One is that we do not want our organization to get into the habit of making any difference whether it is on a commssion or a lump-sum basis. If you give the owner an estimate of his building, then it is everybody's purpose to keep within the estimate. The other reason is that we think it is only fair that the owner should know what the building is to cost, and we sometimes guarantee that the work will not exceed a certain maximum sum.

The owners should be satisfied, even though it may be a little more expensive to have the work done on a commission basis as it saves them in other ways. For example, it gives the owner a chance to make changes and to have the work done in just the way he wishes, so as not to interfere with his business. Personally, I do not think it costs any more to do the work on a commission basis, especially if the contract covers several buildings or a long period of time. We now have three contracts on a commission basis which are yearly contracts; that is, unless they are cancelled before the close of the year, they carry over to the next year.

I think the principal objection to percentage work is that the owners do not sufficiently trust the contractors. I know many honest contractors; but, just as in other business, there are some who are not honest.

We sometimes let some of the work to sub-contractors on a commission basis, but never when the work is of such character that it must be prepared away from the building, such as mill work, steel work, ornamental iron, etc. We have done our own plastering work, but we do not find it very advantageous, because most sub-contractors look after the work themselves as foremen. Fireproofing, painting, and other trades are usually sub-let. Most people agree that to get some one who knows how to do it is worth the profit they pay to the contractor.

Value of Creating Interest.—It is essential that sub-contractors and all others connected with a piece of work shall take interest in facilitating the work. Little progress can be made unless everyone is doing his part. We sometimes go so far as to stimulate interest among those furnishing the materials. For example, some one may be sent out to meet the superintendent of the brick plant, from whom the bricks were bought. In fact, our representative may meet the man who writes out the bills, and also the man who loads the cars. To be more specific, during the construction of the Statler Hotel we had a man at the stone quarry who saw that the stone was shipped just as we needed it; he stayed there two or three months. The lower courses were shipped first, but even then we paid a large demurrage.

During the construction of so large a building, especially if the contractor sometimes pushes the work to the inconvenience of the sub-contractors, all kinds of intricacies may arise, most of the trouble being brought about by the action of one sub-contractor against another. The steel contractors, in this instance, feeling that Mr. Stuart was rushing them a little too strongly, endeavored to have the building department criticize and find fault with the fireproofing, so that by stopping the fireproofing contractor the steel erectors would gain time to work ahead of the fireproofers. The same trouble was experienced with the plumbing contractors; and unless a building inspector is just and reasonable in his judicial capacity, no end of trouble and expense might be caused to the general contractor and to the owner.

Detailed Estimates.—Estimating is becoming more and more standardized. A great many estimators figure work on the same basis. The estimating in Europe is done by professional estimators, or "surveyors," as they are called. In England one surveyor will make an estimate and give it to the different contractors. I think it has been attempted here a number of times, but it does not seem to be satisfactory.

In making our estimates, we obtain the price of cement delivered; we get the cost of the aggregate; we obtain from the specifications the amount of cement required and the ratio of the concrete mixture; we figure minutely just what the material is going to cost; and we then add the cost of the labor. For the reinforcement, we get the prices per pound, and then compute the amount of reinforcement required for the entire job. The principal element of variation in reinforced concrete is with the wooden forms. We figure the number of feet of lumber which will be required for the framework for the entire job. We do not try to compute the formwork at so much per yard, as it will vary on different buildings, depending on the thickness of the slab, and on other details which vary with every job. It ought, theoretically, to vary almost every day.

Cleaning a 27-year-old sewer at Manistee, Mich., obviated the necessity of rebuilding a section of 4 ft. in diameter for which the city was about to issue bonds for $30,000 when the city-manager form of government went into operation. Carl E. Ruger, at the City Manager's Conference in Springfield, December 3, stated that 1,102 tons of sand and refuse were removed from the conduit at a cost of $1,200. After cleaning the various branches the system was found adequate, hence the manager has postponed indefinitely the necessity for the bond issue.

The following mixture has been used by the United States army engineers in waterproofing cement: One part cement, 2 parts sand, ¾ lb. of dry powder alum to each cubic foot of sand. Mix dry, and add water in which ¾ lb. of soap has been dissolved to each gallon. This is said to be nearly as strong as ordinary cement, and is quite impervious to water, besides preventing efflorescence. For a wash a mixture of 1 lb. of lye and 2 lbs. of alum in two gallons of water is often used.

Cost of Floors for Buildings

PRICES of floorings for buildings based on estimates of cost in place are given in a paper entitled "Floor Surfaces in Fireproof Buildings" delivered by Prof. Sanford E. Thompson December 2 at the thirty-fifth annual meeting of the American Society of Mechanical Engineers. For the materials like hardwood that are laid after the partitions are placed, the prices apply more particularly to a building such as a college or other institution divided into offices and rooms of various sizes. Each price is assumed to include total cost of labor and material, exclusive of the structure itself. It is assumed that the base upon which the floor is laid is either structural concrete or some similar material.

Unit Costs of Floorings

	Cost per sq. ft.
Granolithic	
Laid at same time as base; trowelled surface . .	$0.05
Laid at same time as base; ground surface	0.08
Laid after completion of base; trowelled	0.07
Laid after completion of base; ground	0.10
Linoleum	
Battleship linoleum, including $0.03 per square foot for placing and trowelling a ¾-in. layer of mortar immediately after base concrete is laid, linoleum being figured at $1.30 per square yard, cemented in place	0.18
Hardwood*	
Maple or birch, single thickness, including $0.01 for levelling off base concrete and including stringers with cinders between, with rough 1-in. floor underneath	0.22
Maple or birch, single thickness, including $0.01 for levelling off base concrete and including stringers with cinders between	0.18
Maple or birch, single thickness, including $0.01 for levelling off base concrete and including stringers with cinders between, with rough 2-in. floor underneath	0.25
Terrazzo	
With small stone ⅛ to ½-in., including $0.01 for levelling the base concrete†	0.19
With large stone ⅜ to 1-in., including $0.01 for levelling the base concrete†	0.24
Base 6 ins. high, per lin. ft.	0.36—0.50
Marble Mosaic	
Grouted and ground	0.50—0.60
Magnesium Composition	
For large areas, say 100,000 sq. ft., including $0.01 for levelling base concrete	0.20
For small areas, say 25,000 sq. ft., including $0.01 for levelling base concrete	0.24
Asphalt Flooring	
Including $0.01 for levelling base concrete	0.15—0.17
Asphalt Mastic	
For areas 100,000 sq .ft. or more including $0.01 for levelling base concrete	0.15—0.16
In chemical laboratories	0.17—0.18
6-in. sanitary base, per lin. ft.	0.25
Tile	
Quarry tile	0.35—0.40
Fancy pattern tile	0.50
Cork Tile	
Moravian tile, fancy pattern	0.75—1.25

*These prices are based on good quality of hardwood at about $45 per 1,000 ft. b.m.

†For areas of 50,000 sq. ft. or more, deduct 10 per cent. from these figures.

Concrete Work on the New Reservoir of the Montreal Water and Power Company

A NEW reservoir for the Montreal Water and Power Company, near the corner of Maplewood Avenue and Bellingham Road, Outremont, is nearing completion. One section is practically finished, and the other will be ready next spring.

The reservoir, which is one of the units of a comprehensive plan for the supply of water to the large territory lying between one hundred and two hundred feet above the river level, will have a capacity of 45 million Imperial gallons and is situated at an elevation of 365 feet above the river. It is irregular in shape, approximately 700 feet long by 325 feet wide, and is divided into two parts by a concrete wall across the narrowest width.

The site originally purchased for this purpose some twenty years ago was found to be much too small when the time came to take up the work, and the only property obtainable for extension lay higher up the slope. Thus the quantity of excavation was much larger than would have obtained on a site at the lower level. A concrete gate house is situated at the north west corner in which are placed all the valves necessary for the control of the water. Ludlow valves, supplied by Drummond, McCall & Company, Montreal, are used in the gate house.

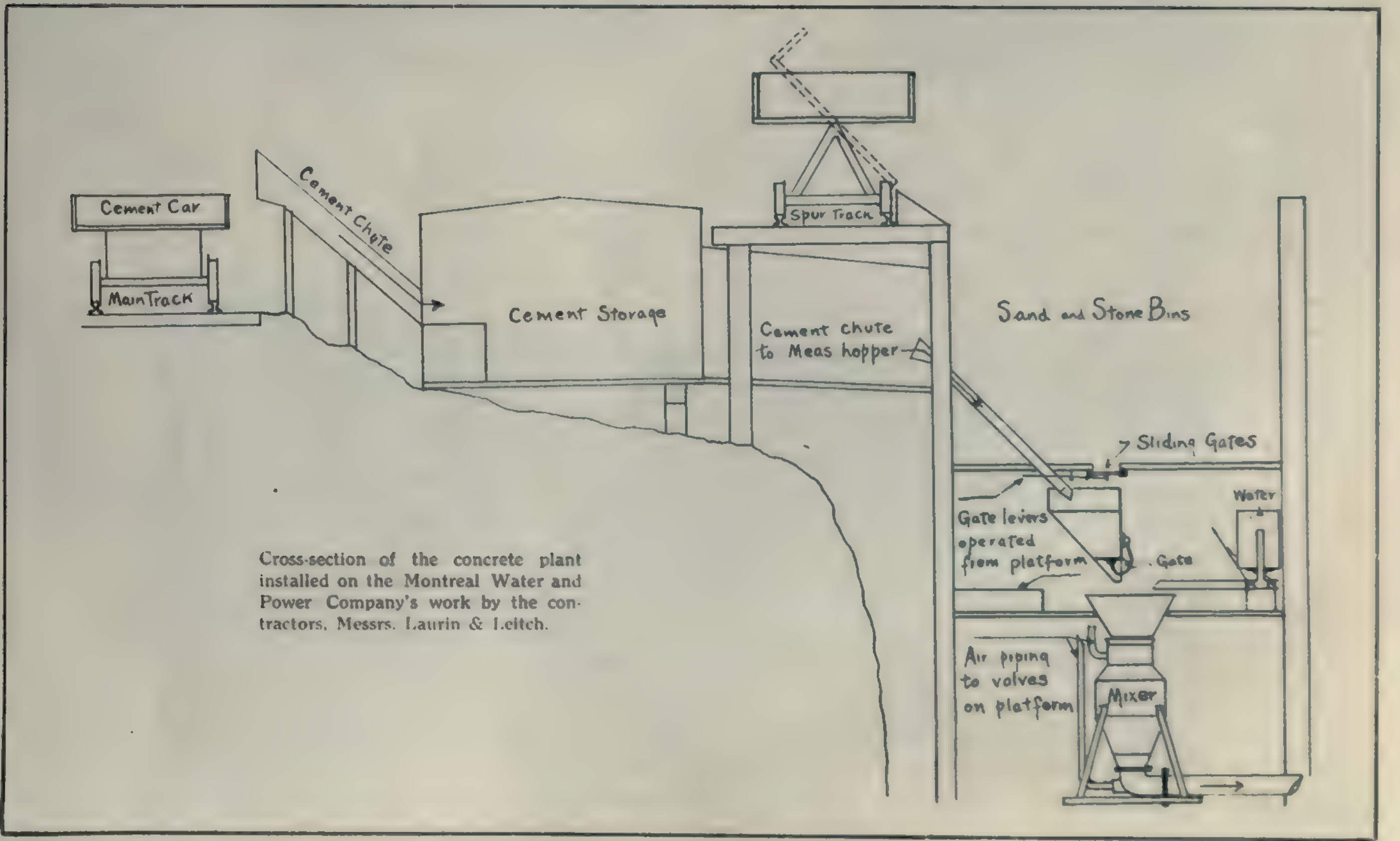
Connection is made with the distribution system by means of 48-inch cast iron pipe, one branch to each section of the reservoir, and 20-inch drains are provided for cleaning purposes.

When completed, the property will be graded, sodded and surrounded by an ornamental iron fence which will give it an attractive appearance in keeping with the development of the neighborhood.

Work was commenced about four years ago, and the extensive character of the job may be judged from the fact that over 400,000 yards of rock have been taken out, in addition to that for the pipe trench 30 feet deep, to give connection with the distribution system. The rock was of a very hard nature, with no beds, and with a tendency to break into large masses. Charges of 60 per cent. forcite were used for blasting.

The contractors, Messrs. Laurin & Leitch, of Montreal, installed a very extensive and complete plant, including stone crushing machinery, the surplus product from which was sold. These stone crushers consist of five Gates gyratory machines, supplied by the Allis-Chalmers Company, in addition to one set of 24-in rolls. Stone not required for immediate use was dumped into a yard, by means of belt conveyors.

The rock was drilled by Temple electric air drills, manufactured by the Canadian Ingersoll-Rand Company, and after being blasted was loaded on to cars by two steam shovels, supplied by the Vulcan Steam Shovel Company, Toledo. The cars were electrically operated on a third rail system of tracks, the contractors having installed a plant for generating electricity, used for this track and for other purposes. The system is known as the Woodford central control system; the tracks were divided into sections, allowing of the current—220 volt d.c.—being turned into any section of track desired. The track was taken up and moved to various points as the exigencies of the work demanded. The cars were carried from these points up a timber trestle to the crusher, and the contents there dealt



Cross-section of the concrete plant installed on the Montreal Water and Power Company's work by the contractors, Messrs. Laurin & Leitch.

Forms for North and West walls.

with. The switches were all electrically operated from a central tower, so that the cars could be shifted as required.

As constructed, the walls on three sides and the lower half of the fourth side are native rock and the only part built of concrete is the upper half of the north wall and the division wall. It was, however, found necessary to line a part of the rock face of the west wall and the lower half of the north wall with concrete, owing to very bad fissures and faults which occur near the surface of the entire site, and similar work will have to be done on a portion of the eastern section. The concrete mixing for the floor was done by two 21-foot Ransome mixers (supplied by F. H. Hopkins & Company, Montreal), gasoline driven. The concrete was spouted down from the two Ransome mixers placed on the top of the north wall, into steel cars, run on a portable track to any part of the reservoir.

The rock face on part of the west wall and south wall from the bottom to the water line has been treated with the Cement Gun, supplied by the Cement Gun Company, Inc., New York, to fill up the crevices and provide a smooth surface. We have already described the general operation of the machine, and the contractors state that it has done excellent work on this job. The bottom of the reservoir was cleaned up by hand labor, and the rock sent to the crushers.

The material for the concrete dividing wall as well as for most of the north wall was mixed and deposited by means of a MacMichael patented pneumatic mixer, controlled by the Pneumatic Concrete Placing Company of Canada, Limited, Montreal. The concrete was mixed and placed by compressed air, using a No. 2 Pneumatic mixer, which has a capacity of ½ cubic yard of mixed concrete per batch.

The compressor supplying the air was a steam-driven Sullivan Class WB2, with a piston displacement of 706 cubic feet per minute, giving a pressure of 80 lb. at the mixer. It was located about 1,100 feet from the mixer, in the central power plant, the air being led to the mixer through a 6-in. line, with a storage tank at each end of the line. One tank of 160 cubic feet capacity was located about 30 feet from the compressor, and the other, of 50 cubic feet capacity, stood about 10 feet from the mixer.

One of our cuts shows an approximate section through the concrete plant and the arrangement of tracks, cement shed, stone and sand storage bins, measuring hopper, water tank and Pneumatic mixer. Cement was unloaded from electric cars on the main track, which ran along one side of the job. The sacks were thrown from the cars into covered chutes which led them down to the cement shed, where they were stored until needed. For the unloading of sand and stone, a standard gauge spur from the main line was laid on a short trestle running past the bins. Stone was obtained from the crusher plant and dumped di-

Centre wall and part of North wall.

rectly into the stone bin over the mixer from side dumping cars of 6 cubic yard capacity. The sand, coming in box cars, was shovelled into a large auxiliary bin at one side of the mixer, the sand bin over the mixer being fed from the auxiliary bin by means of a bucket elevator. The sand and stone bins were of 160 cubic yards each.

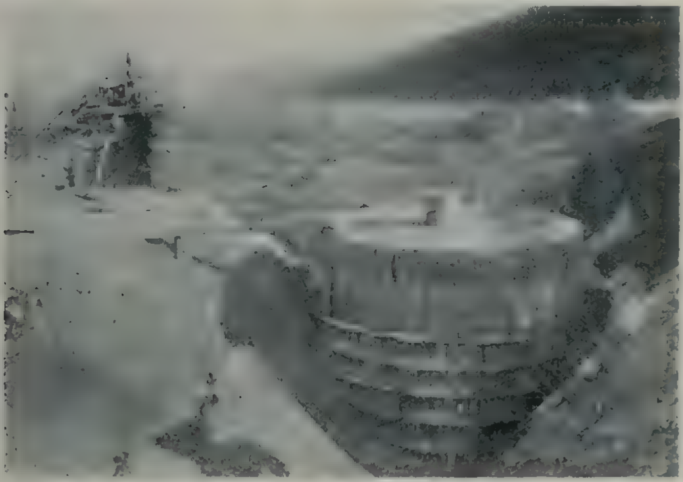
From the storage bins, sliding gates in the bottom, operated by hand levers from below, allowed the materials to fall into the two compartments of the measuring hopper immediately over the mixer, the cement being fed from the cement shed by a gravity chute opening into the stone compartment of the hopper. On opening a gate, the contents of the measuring hopper dropped into the mixer, and at the same time a measured amount of water was directed against the stream of falling materials, all falling into the mixer together.

The pipe for conveying concrete, at the end of the wall, rose about 37 feet, and continued along the top of the forms around curves to the far end. This pipe was 8⅝ in. O.D., made of steel, lapwelded, and weighs about 17 lb. per foot. Slip flanges of special design made connection and disconnection an easy matter. At any joint, an elbow could be bolted on and the concrete directed into the forms from that point, allowing the stream to shoot directly to the form or employing a "bootleg" to spread the concrete in wide forms. Both methods were used as occasion warranted. The pipe was well tied to the forms at bends, on account of the impact of the batches, which, travelling at great speed tend to move the pipe. In the dam the locomotive crane handled the large plums and shifted the riser pipe from section to section as they were poured, the main pipe being laid on the ground at the foot of the form. Each section was poured in three lifts, the conveyor pipe rising for the lifts, 15 feet, 30 feet, or 37 feet.

The pneumatic mixer is of the approximate form of an inverted cone, the conveyor pipe being connected at the point of the cone. The air-piping was so arranged that the operator stood beside the measuring hopper in front of three handles which operated air cocks, and with the top of the mixer in view, at floor level. Two gauges showed the pressure of the air supply at the mixer and the pressure in the mixer during the time of discharge. The three air-cocks shut the door of the mixer after the material had been put in, admitted air over the material, and admitted a jet of air to the bottom of the mixer, and were operated in the order named. With the arrangement of bins used, the actual mixing and placing required only a few seconds, and with a given amount of air the time required for a complete cycle, charging and discharging, depended only on the personnel of the operators and the length of shot.

The entire arrangement of concrete plant was designed to obtain maximum economy and speed, and with a view of eliminating delays due to bad weather.

The greatest distance the charges were conveyed was 600 feet, which includes a 37-foot rise from the ground to the top of the forms at about 100 feet from the mixer, curves between mixer and discharge elbow aggregating 300 degrees on this shot. The operation at this distance was slower than at a shorter distance on account of the greater volume of air required to discharge, a wait for the air pressure to rise being necessary between shots. The wall was poured in lifts of 3 feet, and in alternate sections, which would require more than the average amount of labor expended to change the point of discharge. The speed of shooting at 400 feet was 1 batch per minute. On one lift of the dam, the pipe being 315 ft. long including a rise of 16 feet at the end, the speed of shooting was one shot in 47 seconds.



Gate-house, with Ransome mixer.

Pneumatic concrete conveyor pipe pouring dam.

The gang operating the plant comprised about eight men, including the foreman, distributed as follows:—two carrying cement to chute and dumping sacks; two operating levers admitting materials to measuring hopper; one operating watertank lever, and assisting mixer-operator; one mixer-operator at air valves, and admitting materials to mixer; one to four at discharge and spreading concrete in wide forms; one foreman. This gang shifted the discharge pipe when necessary.

The stripped concrete shows a smooth surface and a close grained dense mixture. On account of the force with which the batch leaves the pipe, it was decided that the concrete would not require spading or tamping to make a smooth surface, which decision the results verified completely.

The plant for generating the electric current included a 750 h.p. Belliss and Morcom engine, supplied by Laurie and Lamb, Montreal; a C. G. E. d.c. generator and motors to operate the cars carrying stone to the crusher plant; an Allis-Chalmers a.c. generator for the various other motors employed on the job; the motors on the cars were of C. G. E. make.

The general scheme, including the reservoir as described above, was designed by Mr. F. H. Pitcher, General Manager and Chief Engineer, and Mr. W. H. Sutherland, Assistant Engineer, of the Montreal Water and Power Company.

Unit Costs of Resurfacing Portions of the Niagara River Road in Queen Victoria Park[*]

In reconstructing a five-mile section of the Niagara River Road in Queen Victoria Park cost data were obtained of considerable interest. The road was formerly constructed as waterbound macadam, the width of macadam pavement being 18 ft. Reconstruction work was divided into three parts, i.e., light resurfacing, heavy resurfacing in which the entire top course was reconstructed, and a bituminous carpet treatment of another section of the same road. Contractor's profit and overhead cost are excluded.

Light Resurfacing

On this section, which was 2.77 miles in length, the work consisted of spiking up the old surface with a steam roller, repairing depression with new stone when needed, shaping by raking, and watering and rolling. The cost of this work is given in Table I.

Table I.—Light Resurfacing Waterbound Macadam Roadway

Conditions:
August 5, 1913, to October 21, 1913, from Slater's Dock, South.
Average length of haul—3.4 miles from M. C. R. siding, Chippewa.
Length, 14,625 ft. = 2.77 miles; width, 18 ft. = 29,250 sq. yds.

	Total cost.	Cost per sq. yd. cts.
Labor:		
Loading 2-in. stone and screenings	$232.56	.8
Hauling	442.95	1.51
Pumping and watering	45.29	.15
Repairing roadway	275.18	.94
Rolling and spiking	97.29	.33
	$1,093.27	3.73
Material:		
2-in. stone—205.5 tons at $1.25	256.88	.88
Screenings—150.2 tons at $1.00	150.20	.51
	$ 407.08	1.39
Summary:		
Labor	1,093.27	3.73
Materials	407.08	1.39
Totals	$1,500.35	5.12
Cost per mile	540.00	....

Remarks:
297 cu. yds. of stone and screenings were placed on 29,250 sq yds.
1 cu. yd. of stone and screenings was placed on 98.5 sq. yds.
Ratio of 2-in. stone to screenings used—1 to .731.
Ton-mile cost of hauling materials—36.2 cents.

Wage rates:	
Teams, per hour	$0.55
Laborers, per hour	.22
Foremen, per hour	.30

Heavy Resurfacing

On this section, 2.74 miles in length, the top course of the road was scarified, new stone added and the top course finished as in new macadam construction, by flushing and rolling. The cost of this work is given in Table II.

Table II.—Heavy Resurfacing Waterbound Macadam Roadway

Conditions:
August 1, 1913, to December 15, 1913, from Black Creek, North.
Average length of haul—1.98 miles from Black Creek siding.
Length, 14,467 ft. = 2.74 miles; width, 18 ft. = 28,934 sq. yds.

	Total cost.	Cost per sq. yd. cts.
Labor:		
Loading 2-in. stone and screenings	$ 521.00	1.8
Hauling	1,509.00	5.2
Pumping and watering	215.00	.8
Repairing roadway	547.00	1.9
Rolling and spiking	425.0	1.5
	$3,217.00	11.2
Material:		
2-in. stone—750 tons at $1.10	825.00	2.9
Screenings—324½ tons at $1.10	357.00	1.2
	$1,182.00	4.1
Summary:		
Labor	3,217.00	11.2
Materials	1,182.00	4.1
Totals	$4,399.00	15.3
Cost per mile	1,600.00	....

Remarks:
895.4 cu. yds. of stone and screenings were placed on 28,934 sq. yds.
1 cu. yd. of stone and screenings was placed on 32.3 sq. yds.
Ratio of 2-in. stone to screenings used—1 to .433.
Ton-mile cost of loading and hauling materials—32.3 cts.

Wage rates:	
Teams, per hour	$0.45
Laborers, per hour	.20
Foremen, per hour	.30

At Queen Victoria Park rates for teams, 55 cts. and men, 22 cts., the above ton-mile cost would be 38.4 cts.

Bituminous Carpet Treatment

A section of road 2.77 miles in length was covered with a bituminous carpet. A refined tar known as

Table III.—Bituminous Carpet of Tarvia A and ½-in. Stone

Conditions:
September 2 to October 16, 1913, vicinity of Usher's Creek.
Length of haul—3.4 miles.
Length, 14,625 ft. = 2.77 miles; width, 18 ft. = 263,250 sq. ft. = 29,250 sq. yds.
Depth—½ in.

	Total cost	Cost per sq. yd. cts.
Costs:		
Loading, hauling and placing stone	$ 861.05	2.90
Loading, hauling and placing tarvia	353.71	1.19
Placing and removing plant	56.50	.19
	$1,271.24	4.28
Materials:		
½-in. stone—487.5 tons at $1.30	633.75	2.14
Tarvia "A"—14,307 gals. at 10c.	1,430.70	5.58
Freight $188.35; demurrage, $32	220.35	
Soft coal for heating and operating roller	88.90	.30
Totals	$2,373.70	8.02
Summary:		
Labor	1,271.24	4.28
Materials	2,373.70	8.02
Totals	$3,644.04	12.30
2.77 miles cost	$3,644.94	
1 mile cost	1,300.00	
1 square yard cost		0.1230

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[*] From Engineering and Contracting.

"Tarvia A" and ½-in. stone chips were used. The tar was shipped in tank cars to the nearest railway siding and heated by means of a steam boiler to a temperature of 100 deg. F., when it was forced by steam pressure into the distributing apparatus, and then hauled to the site of the work and attached to the steam roller. Connection was here made to the boiler of the roller and the tar heated to a temperature of between 175 deg. and 200 deg. F. Steam pressure at 35 lbs. was then applied to spray the tar from the distributing machine onto the road. The distributing apparatus used was supplied with nozzles at the rear through which the hot tar was forced in a fine spray.

The portion of the hot tar that did not penetrate the road surface was absorbed by ½-in. stone chips applied at a rate of 1 cu. yd. of chips on 65 sq. yds. of surface, the depth of stone and tar being slightly over ½-in. Tar was applied at a rate of ½ gal. a square yard. As shown in Table III. the total cost, including labor, was $0.123 per square yard, or about $1,800 per mile for an 18-ft. roadway.

It is estimated that the only cost of upkeep for this surface will be an annual tar spraying, using about ⅛ gal. of tar per square yard, at a cost of between 3 and 4 cts. per square yard, or about $320 per mile for an 18-ft. roadway.

To Clean Bricks Blackened by Smoke

FOR the cleaning of bricks in the walls of a church that had been blackened by coal smoke and which settled on the coping and washed down over the light-colored pressed bricks, and where dilute muriatic acid, pearline and other substances had been tried without satisfactory results, the following is recommended:—Muriatic acid will not remove smoke stains, nor will soda or soda ash do it. Smoke stains must be removed by scrubbing and rubbing with the proper solutions. Try the following method: Mix one gallon soft soap, two pounds powdered pumice and one pint of liquid ammonia, beating the mixture well. After carefully dusting the brickwork, apply the mixture. This should be in the form of a soft paste, in a fairly thick layer with a fibre brush, allowing it to remain for about twenty minutes; then rub it in on the bricks with a good, stiff scrubbing brush, using plenty of elbow-grease. Use a large sponge and plenty of lukewarm water to remove the lather, and then rinse with clear water, or, if convenient, use a hose for rinsing. This, if properly done, will remove the most stubborn case of discoloration by smoke from bricks.

Dust Prevention in Cement Works

CEMENT dust is irritating not only to those who are compelled to work in it, but also to the occupants of buildings and land in the vicinity of cement manufactories. One method of dealing with the problem, pointed out by Ferro-Concrete, is that worked out by Mr. T. J. Fleming, the general manager of the California Portland Cement Company, of Los Angeles. At the Colton works of this company a dust collecting system has been installed for five rotary kilns, each with a capacity of 750 barrels a day.

The dust house contains two departments, one for the dry and the other for the wet treatment. The former is a room, 155 ft. long by 100 ft. wide by 31 ft. high, where the dust-laden gases are received direct from the fans. The building is of steel frame construction, the sides and roof covered with galvanized corrugated iron in order to assist radiation. There are ten cross tunnels leading to a longitudinal tunnel running parallel to the dust chamber. In these cross tunnels are screw conveyors for drawing off the dust, which is discharged into a conveyor in the longitudinal tunnel, continuously delivering the dust back to the mixing department whence raw material is supplied to the kilns.

In the washing department of the dust house, there are five chambers, each 60 ft. long by 20 ft. wide, with brick-lined walls and a reinforced cement roof. After the gases from the kilns have deposited part of the dust in the dry department, they enter the wet treatment chambers and pass over a series of baffles arranged so that the gases have to pass through water and finally through a screen of atomized water and steam. The water overflowing from the wet chambers contains about 0.1 lb. of cement dust in suspension, and an equal amount of cement in solution, and is discharged into primary and secondary steel settling tanks of conical form. The thick slurry from secondary tanks is continually pumped back to the kilns, being mixed with dry material from the raw material department.

It is stated that the total amount of dust recovered daily amounts to about 75 tons, 50 tons from the dry department and 25 tons from the wet department. The power continuously required for the plant, including that for the slurry pumps, circulating pumps and conveyors, is 120 horse-power, approximately, to which must be added that for operating the fans and handling the hot gases from the kilns.

Moving pictures portraying engineering construction in actual progress formed one of the features of a recent meeting held by the Western Society of Engineers. The pictures were shown in two reels, one devoted to highway construction and the other to the manufacture of concrete fence posts, tile and silos.

When it is desired to flatten out old mounted plans, old paper drawings or old cloth or paper prints, the following method has been found to work successfully in every instance where harsh handling or reverse rolling would ruin the appearance of a drawing. Make a thick, boiled starch of flour by boiling flour and water down to almost the consistency of thin dough. Lay the plan out bottom up on a flat surface and apply the starch as a paint, thoroughly rubbing it into the surface. Keep the plan perfectly flat until dry and then it will be found that it will remain smooth. The flour starch will not injure the plan in any manner. This method was found to be the only successful way of treating a large number of old railroad plans which had to be flattened out for filing in drawers.

Burning Empty Dynamite Cases is discussed in the DuPont Magazine. It is essential in destroying dynamite to take it out of its wooden case, as the nails are apt to cause an explosion when the flame reaches them. Any cases showing signs of being stained with nitroglycerine should not be used for fuel but burned in the open. A little excelsior or waste should be soaked in gasoline and placed under the empty cases. One end of a piece of fuse 2 or 3 ft. long should then be lighted and the other end placed in the excelsior, or the workman may lay a train of excelsior, light one end with a match, and run.

Design and Maintenance of Sewage Treatment Works[*]

THE use to which a stream is put and the available water for dilution should be factors in the design of every plant, and treatment should not be carried further than is made necessary by the conditions of the stream which is to receive the sewage after treatment. Where streams are used as sources of water-supply for near-by towns, a higher standard of effluent is required than where the purpose of the treatment works is only to prevent nuisance.

All disposal works should be recognized as machines which require intelligent supervision and which, if properly designed and maintained, can be made to produce just that quality of effluent which the diluting capacity of the local stream will render satisfactory. In this way greater general progress in the betterment of stream conditions will result.

It will frequently happen that, in small streams, the dry-weather flow can, with profit, be increased by the intelligent use of stored upstream water, and the discharge of a partly treated sewage thus made possible at all seasons.

Where the two-storey type of tank is adopted care must be exercised that the tanks are not made too large, as under such circumstances they are liable to fail of their purpose by reason of the sewage in the settling chamber becoming septicized and creating nuisance.

Patented Processes.—Town authorities should not deal with the proprietors of any patented processes or devices for sewage treatment without the assistance of some competent advising engineer.

The treatment of sewage has always seemed to be a particularly fertile ground for the exploitation of patented methods, from the early days of the many processes of chemical precipitation to the present-day electrolytic treatment; many of these schemes, while apparently successful in the experimental plants, are entirely infeasible on a practical scale. There is danger in deducing results from small test apparatus without scientific study by a qualified expert; often the cost of such treatments, when undertaken practically, is prohibitive. The proprietor of a process who is looking for a contract will give a bond and make various propositions which appeal to the people of a town and in this manner lead them to favor the acceptance of such propositions. Many costly mistakes have been foisted on communities in this way.

Processes of Treatment

Sedimentation and Sludge Digestion.—Usually the first process of treatment is the removal of the solid matters which have been maintained in suspension by the velocity of flow in the sewer. In the past, when the solids were allowed to settle in tanks in which the sewage flowed over and in contact with the putrescent deposits in the bottom, odors resulted. Also, when the deposit from such tanks, called sludge, was placed upon the ground or upon drying beds, the foul emanations added to the nuisance. But within recent years, two-storey tanks have been devised and are in successful operation whereby the sewage is settled for a short period of time in the upper storey and the sludge allowed to remain in the lower compartment of the tank sufficiently long for the decomposable matters to digest, and the settling sewage is kept from coming in direct contact with the digesting sludge.

Such tanks will discharge an effluent practically free of settleable matter in nearly as fresh a condition as when received. The gases evolved during digestion of the sludge away from contact with the sewage are principally methane or marsh gas and carbon dioxide, both of which are inodorous. Sludge withdrawn from such tanks after digestion is inoffensive, dries quickly and may be used for filling low land or for agricultural purposes with no danger of nuisance.

Oxidation.—If the conditions require more refined treatment than sedimentation, it becomes necessary to adopt processes for oxidation. This may be accomplished by means of intermittent sand filters, contact beds or sprinkling filters, the choice of which is largely dependent on the availability of different construction materials and the size of plant to be installed. Intermittent sand filters are only economical where large areas of sandy soil are available. The sprinkling filter, on the score of economy and on account of the maximum efficiency secured on a minimum area of land, is generally given preference; yet under certain conditions contact beds are justified.

The present-day tendency is to adopt processes which will maintain, as far as possible, aerobic conditions in the liquid at all stages through the plant; the maintenance of such aerobic conditions is the primary consideration in avoiding nuisance.

Disinfection.—As the purpose of disinfection is the destruction of pathogenic bacteria, in order to provide a double safeguard against water-borne diseases, it can be generally said that disinfection of sewage is an unnecessary refinement, unless the effluent of the sewage-treatment works is discharged into a water course adjacent to and above the intake of a water-purification plant, and even in such a case the responsibility of protecting the public health should rest upon the purification of the water.

It is not practical to disinfect crude sewage containing particles of organic matter of appreciable size, as with the usual period of contact it is impossible for the disinfectant to penetrate the solids.

Odors and Their Avoidance

The amount of odors depends largely on the freshness of the sewage and the method of treating and handling the sludge. The freshness of the sewage depends largely on time of travel and the design of the collecting system, on the adaptation of size to discharge, the provision for self-cleansing velocities and on the ventilation of the sewers so as to provide as much natural aeration to the liquid as possible. If the sewage is fresh or if, in other words, it contains dissolved oxygen, there will not be serious odors from the application or treatment of the liquid portion, provided the plant is maintained with no lodgment of sewage in pools or overloading of the surface of the filters.

There is a potential cause of odors in the sludge. But by the use of the more modern type of tanks, with thorough digestion of the decomposing solids and discharges on properly prepared sludge-drying beds, under favorable weather conditions, no odor of serious moment, noticeable more than a few hundred feet, should ever occur. Odors can be largely eliminated by good design, but their occurrence depends more particularly on proper supervision of the plant.

By the use of the two-storey sedimentation tanks, which provide for the digestion of sludge, and by care in the management of the works, plants are operated in Europe and in this country where no oders are noticeable either from the sewage or from the sludge during drying.

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[*] Condensation of a Progress Report of the Committee on Sewerage and Sewage Disposal, presented to the Sanitary Engineering Section of the American Public Health Association, Jacksonville, December, 1914.

In plants where other methods of treatment are adopted it is probable that odor will be produced. It has been estimated that at such a plant capable of treating the sewage of 50,000 people, with good management no odors should ever be apparent beyond 1,000 to 1,200 feet from the works, even when sludge is being discharged upon the drying beds or in the spring when the filters are in bad condition, due to the past winter interfering with work being done on them.

With smaller plants this distance should be less, and with larger plants possibly more. By diffusion, of course, the odor becomes more faint as the above-named distances are reached, and beyond these distances no odor should be noticeable. What might be termed odors, strong enough to be disturbingly disagreeable to a person whose nasal sensitiveness is not affected by his knowledge of the source of the odor, should, perhaps, never be found at a distance more than one-third of those mentioned. It should, however, be noted that an odor from a sewage plant which, if from a farm would never be noticed or would be accepted as simply natural and reasonable, will generally develop complaints of nuisance. Sentiment, regardless of facts, frequently blames on an inoffensive sewage-disposal plant bad odors from other sources. In short, sewage-treatment works should be as isolated as is economically possible.

For the avoidance of odors, the fundamental considerations are the delivery of the sewage as fresh as possible at the plant, the application of the liquid portion to filters before the sewage has become stale, and the proper treatment of the sludge so as to render it comparatively odorless and easily handled.

Making Sewage-Works Attractive by Planting Trees, Shrubs and Flowers

Disposal plants should be made attractive by planting and parking, and no money can be better spent than this. The trees to some degree prevent the spreading of the odors, and in the planting of trees and shrubs the direction of the prevailing wind should be taken into account.

Local authorities, when they first take up sewage-treatment for consideration, frequently look upon the plant as a dump for municipal waste, and it never occurs to them that it is good policy to spend money to make the works so attractive that people will voluntarily make it the objective point of their Sunday afternoon strolls.

Such beautification and the proper maintenance of the appearance of the plant are the surest and best means of preventing complaints of odors or nuisance; this because of the psychological effect on those living near the plant, and also on the attendants, who unconsciously adopt a higher standard of cleanliness and care of the works.

IT is generally admitted that mountain railways of the aerial cable type cost less to construct than the funicular, and in Switzerland there are several under construction. L'Electricien of Paris describes a new ropeway recently constructed near Bozen, where there is a rise of 2,750 ft. in 5,400 ft., and an average inclination of 43 deg. The two cars, one of which ascends while the other descends, are connected by a cable in duplicate. The up and down lines are 20 ft. apart, and each consists of two steel cables 20 in. apart, on which runs a four-wheel trolley, to which the car is attached. The double cables which draw the cars are operated by an electric motor fixed at the highest station. The supply of current, which is taken from a central station, is supplemented by a battery for emergency use. Hand gear on the car is also provided. All cables are in duplicate, and a large factor of safety has been allowed. The ropeway is supported on steel towers, 56 ft. being the maximum height, and the longest span 1,300 ft. The cars take eight passengers inside and eight outside.

Macadam pavements have been laid in Winnipeg, since 1894, to a total of nearly 600,000 square yards. Since 1901 nearly 165,000 square yards have had to be removed.

Book Reviews

American Sewerage Practice; Vol. I., Design of Sewers; by Metcalf & Eddy. Published by the McGraw-Hill Book Company, Inc., New York City. Price $5 Net. This is the first of three volumes which will treat of the more important principles of theory and rules of practice in the design and operation of sewerage works. This first volume deals with the design of sewerage systems, the second will cover their construction and the third will be devoted to the design of works for the treatment and disposal of sewage. The introduction to Vol. I., which deals with the lessons taught by early sewerage works, contains some particularly interesting historical data. An idea of the scope of the book may be obtained from the subjects of the various chapters, which are as follows:—The General Management of Sewerage Systems; Flow of Water in Pipes and Channels; Velocities and Grades; Measurement of Flowing Water; Quantity of Sewage; Precipitation; Formulas for Estimating Storm-Water Flow; The Rational Method of Estimating Storm-Water Run-off in Sewer Design; Gauging Storm-Water Flow in Sewers; Sewer Pipe; The Design of Masonry Sewers; Examples of Sewer Sections and the Loads on Sewers; The Analysis of Masonry Arches; Street Inlets, Catch-Basins and Manholes; Junctions, Siphons, Bridges and Flushing Devices; Regulators, Overflow, Outlets, Tide Gates and Ventilation; Sewage Pumping Stations. The volume is a comprehensive one. Its pages number 750 and its illustrations 328. The illustrative details are particularly complete and illuminating. Vol. II., The Construction of Sewers, is now on the press, and Vol. III., The Disposal of Sewage, is in course of preparation.

New Time Savers in Hydraulics and Earthwork, by C. E. Housden London: Longmans, Green & Company, 39 Paternoster Row. Price 3s. Net. These time savers consist of the author's "Hydraulic Scales," from which the dimensions of pipes, drains and sewers can be ascertained easily and accurately, and his "Rapid Earthwork Calculation," from which the quantity of earthwork required in a bank or cut can be quickly calculated to, if necessary, the nearest inch of its depth,—strongly bound together into one convenient-sized manual. This little work contains useful tables and diagrams the application of which should be found valuable by municipal engineers and others. The author was formerly Superintending Engineer in the Public Works Department of India.

"Oxy-Acetylene Welding and Cutting and Its Application," is the title of a booklet received from L'Air Liquide Society, Montreal. This booklet deals with the numerous applications of the oxy-acetylene blow pipe and contains interesting information concerning the manufacture of oxygen.

A bulletin recevied from Messrs. Canadian Allis-Chalmers, Limited, Toronto, contains detailed illustrated information about Cochrane Multiport Valves, manufactured by the Harrison Safety Boiler Works, Philadelphia. Messrs. Allis-Chalmers are the exclusive agents in Canada for these valves.

Personal Mention

An interesting address on Submarines was given on December 22nd, before the members of the Ottawa Branch of the Canadian Society of Civil Engineers, by Engineer-Commander Howe, of the Royal Navy.

The new Dean of the School of Mining of the University of California is Mr. Andrew C. Lawson, a graduate of the University of Toronto.

Mr. E. Carnegie, of Welland

MR. E. Carnegie, Vice-President and General Manager of the Electric Steel & Metals Company, Limited, Welland, Ont., is a gentleman whose activities will interest many readers of the Contract Record and Engineering Review. Particularly is this the case in view of the fact that quite recently he was appointed a member of the Shell Committee, a technical body which acts in an advisory capacity to the Department of Militia and Defence.

Mr. E. Carnegie.

Mr. Carnegie was born at Aberdeen, Scotland, and educated in that city and at London. He received his technical education at the East London Technical College and the City of London College, and served his apprenticeship with Messrs. Jos. Richmond & Company, hydraulic, mechanical and electrical engineers, of London.

When the Electric Steel and Metals Company, Limited, was organized, in August, 1913, Mr. Carnegie was appointed Director and Secretary-Treasurer. He succeeded to his present office of Vice-President and General Manager only last November.

Mr. Carnegie's firm has a number of important contracts in hand, including one from the Government for shells, and so it is interesting to note the various positions occupied by him during his career. His first important charge was the projectile plant of Messrs. Vickers, Sons & Maxim, at their great works in Erith, in the County of Kent, England. From Erith Mr. Carnegie was appointed to a position in the Royal Gun Factories at Woolwich Arsenal. Later he was engaged by Messrs. Cammel, Laird & Company, of Sheffield, England, on their Foundry and Shell Plant. He was subsequently engaged by Messrs. Thos. Firth & Sons, Limited, of Sheffield, as Assistant Engineer on the installation of their new steel mills, rolling mill and projectile plant.

A tribute to Mr. Carnegie's experience is the fact that he was retained in a consulting capacity, as technical and mechanical adviser, by the Gramophone Company, Limited, London, England—a firm which operates plants in seven countries.

Mr. Carnegie's technical experience is an interesting and useful one, and the various positions that he has held are an eminent qualification for the important work which he is doing at Welland.

Mr. H. M. Ford, recently with the B. F. Sturtevant Company of Canada, Limited, Montreal, has started in business for himself at 802 New Birks Building, Montreal, and is handling the Sturtevant Vacuum Cleaners both of the portable and the stationary type.

Mr. E. D. Tuttle, Architect, Winnipeg, has removed his office to 705 McArthur Building. Mr. Tuttle asks us to draw attention to the fact that he is receiving advertising and other matter through the mail, addressed to Messrs. Jewett & Tuttle, a firm which has not been in existence for many years.

Mr. David K. Trotter, F. I. E. S., has been appointed Secretary of the Montreal Builders' Exchange, in succession to Mr. R. L. Werry, resigned. He was born at Dunfermline, Scotland, and the greater part of his life has been engaged in educational work. There were one hundred applicants for the position.

An interesting paper, entitled "Bridge Building in the Rockies, and Engineering Problems Encountered in the Work," was read at a recent meeting of the Manitoba Branch of the Canadian Society of Civil Engineers by Mr. C. S. J. Wilson, Construction Engineer for the Dominion Bridge Company.

Mr. T. A. Jardine Forrester, Water-Works Engineer for the City of Quebec, delivered an interesting address, "Cast Iron vs. Steel Water Mains," at a recent meeting of the Quebec Branch of the Canadian Society of Civil Engineers. Mr. A. E. Doucet presided over a large attendance of the engineering profession.

It is reported that Mr. J. W. Leonard, Assistant to the President of the Canadian Pacific Railway Company, will be the executive head of the Terminal Company which proposes to erect the new union station in Toronto, at a cost of some $18,000,000. The appointment of Mr. Leonard is taken as a hopeful sign of an early start on the work.

Messrs. Theodore Korner and Robert H. Mattocks, of Vancouver, were awarded the first prize of $500 in the competition for a design for the proposed Civic Centre at Vancouver. Mr. Fred L. Townley, Vancouver, won the second prize. The adjudicator was Mr. Thos. Adams, Town Planning Expert to the Commission of Conservation, Ottawa. Full details are given on another page.

Mr. E. G. Matheson has been appointed Lecturer in Descriptive Geometry in McGill University College, Vancouver, B.C., for the term beginning January, 1915. Mr. Matheson is a B.Sc. of McGill University, and is a member of both the Canadian and American Societies of Civil Engineers. He has recently completed the building of the foundation of the Canadian Pacific Railway's bridge at Pitt River, one of the largest and most difficult pieces of work of its kind in British Columbia.

We regret to record the death of Mr. F. X. Dion, President of the Lauzon Engineering Company, Limited, engineers and contractors, Levis, Que. The late Mr. Dion, who was well known in Quebec, passed away on December 17th, at his late residence at Lauzon.

A Distinguished Architect

MR. E. C. P. Monson is the new President of the Society of Architects, of London, England. We publish in this issue an abstract of Mr. Monson's interesting presidential address before that body last month, and so a few personal data will be of interest.

Leaving school in London, Mr. Monson entered the office of his father (Mr. Edward Monson, J.P., F.R.I.B.A.) and completed his professional education at King's College, where in 1892 he won the Bronze Medal for architectural work.

Mr. Monson has been carrying on a general architectural practice for some years. He has made a special study of the housing of the working classes, in which connection he has visited many of the great Continental cities. He has taken part in several important competitions and won the Gold Medal presented by the National Housing and Town Planning Council for the cheapest and best cottage at the Swansea Model Cottage Exhibition. He is a Fellow of the Royal Institute of British Architects, and subscribes to membership in many other leading professional societies. He is an enthusiastic philatelist and motorist.

About eighteen months ago Mr. Monson retired from the Territorial Forces with the rank of Major and with the Territorial Decoration, the Volunteer Long Service Medal, and the King Edward Coronation Medal.

Trade Conditions at Winnipeg

Office of the Contract Record,
Winnipeg, Jan. 2, 1915.

TRADE conditions at Winnipeg continue to be very similar to those existing at the end of November. Work on almost all the large buildings now under construction is nearing completion, with only the inside finish requiring to be completed. Consequently there is a decline in the demand for building materials—a state of affairs which will continue to exist, in all probability, until work opens up again in the Spring. There is, however, a little work being undertaken at the present. The Board of Control has awarded contracts to the value of $66,000 for the construction of trunk sewers on various streets. This work is being done by day labor to alleviate the unemployment prevailing in the city. Work has also been started on the construction of one of the three wharves which are to be constructed on the Red River by the Department of Public Works. This wharf, which will be 400 feet in length and 30 feet in width, is to be constructed of piles and will cost in the neighborhood of $25,000. Including excavating, dredging river, etc., the total cost will reach $90,000. A portion of this work was performed during the summer months. Work on the Knox Presbyterian Church, which is to cost $225,000, has closed down for the winter months, it being reported that this work will start up again as soon as the weather permits.

Regarding prospects for next year. With the war seemingly not much nearer to its end than a month ago, it is rather difficult to predict what is in store for the building and engineering trades here with any degree of accuracy. There are a few large structures which will be erected in 1915. The Parliament Buildings will be proceeded with, the ultimate cost of which will be $4,000,000. Mr. H. B. Orkin announced that he was going to erect a $175,000 business block on Portage Avenue as soon as the weather opened up. The North End Armoury will also be proceeded with. The greatest of all the work to be done this year is of course the engineering project of the Greater Winnipeg Water District, which work will start on March 6th, 1915. The ultimate cost of this scheme will be $13,500,000.

With regard to prices, there have been no changes in the lumber quotations. Everything is extremely dull in this line, and it is expected that nothing will move now until the Spring.

There is some demand for cement, lime and brick, but it is expected that it will gradually fall off now until the building operations resume again in the Spring. Cement in carload lots f.o.b. Winnipeg, is quoted at $2.30 against the former price of $2.20. The demand for crushed stone, sand and gravel is rather quiet, and although a few sales are being made, they are unimportant. Prices remain as quoted. There is practically no demand for steel and iron at the present time. Prices remain firm. A little business is being done in the sewer pipe line, but taking the demand as a whole, the sales are very poor. The prices are unchanged. There is a fair demand for hard wall plaster, the prices of which remain as quoted. There still remains quite a good trade in paints and oils, although much quieter than last month, owing to the closing up of the building season. This has been the one bright feature of the monthly market conditions, each month having the same state of conditions to report. Whenever one goes into the hardware stores, one always finds the paints and oils counter fairly well occupied. There is only one change to report, that of putty in 25-lb. tins, which is quoted at $3.25 as against $3.35 last month. It is expected that there will soon be a revision of all these prices. Collections are reported good.

A special feature is a further advance of 75c to $1.00 per 100-ft. box on both double and single window glass, of which there still remains a good demand.

Tenders close January 12th for the interior fittings for the new post office at Fredericton, N.B. It is estimated that the contracts will run into more than $130,000.

Messrs. F. H. Hopkins & Company, dealers in railway and contractors' supplies, Montreal, have opened an office in Winnipeg at 1206 Union Trust Building, in charge of Mr. J. W. Purcell.

In March next the Dominion Highway Association and the Ontario Good Roads Association will hold a joint Convention. A Committee consisting of the Presidents, Vice-Presidents and Secretaries of the two Associations has been appointed to make arrangements. The moving spirit in the enterprise is Mr. W. A. McLean, Chief Engineer of the Roads Department of the Ontario Government, Toronto.

Mr. R. J. McClelland, City Engineer of Kingston, has presented his annual report for 1914, which shows considerable activity throughout the year. During the season 4.78 miles, or 118,032 sq. ft. of concrete walks were constructed. Over one mile of sewers were built and 1,500 ft. are now under way. In 1913 the expenditure on concrete work, paving, sewers and general construction was $134,876. The expenditure last year was in the neighborhood of $175,000.

The Secretary of the American Institute of Consulting Engineers advises us that the Annual Meeting of that body will be held on Tuesday, January 19th, at the City Club, 55 West 44th Street, New York City, at 8 p.m. The meeting will be preceded by an informal dinner at 6.30. At the meeting three members of Council will be elected and various routine business transacted. Ballots will be canvassed for the adoption of an amended constitution and by-laws, as prepared by the special committee appointed at the last annual meeting.

Mainly Constructional

East and West—From Coast to Coast

The city of Hull, Que., will expend $200,000 on a turbine pump (capacity 8,000,000) and extensions to the water-mains. The City Engineer is Mr. J. A. Laforest.

At Hamilton, work has been started by day labor on the construction of a storm overflow sewer system at an estimated cost of $300,000. The City Engineer is Mr. A. F. Macallum.

The City Council at Calgary will take tenders for $40,000 worth of steel for the substructure of the proposed bridge over the Bow River at Ninth Street. The total cost of the new bridge is estimated at $165,000.

At Ottawa, a new Bascule bridge is to be erected on Pretoria Avenue at a cost of $120,000. Tenders for the substructure close with the Secretary of the Board of Control on January 28th. The Engineer is Mr. F. C. Askwith.

The Worswick Paving Company, Victoria, B.C., have won a suit for $9,000 against the municipality of Saanich, B.C. The company claim that they lost this amount through the failure of the municipality to carry out a programme of paving drawn up about a year ago.

The Commercial High School, which is being erected at Shaw and Dewson Streets, Toronto, for the Board of Education, by Messrs. R. Robertson & Sons at a cost of $260,000, is to be three storeys high, of brick construction. Good progress has been made on the masonry work to date.

The time for receiving tenders on the new Masonic Temple which it is proposed to erect on Spadina Road, Toronto, at a cost of $300,000 has been extended until January 15th. The architect is Mr. H. B. Knowles, of New York City, and the supervising architects are Messrs. Burke, Horwood & White, Toronto.

The steel construction is under way on the new Registry Office which is being erected on Elizabeth Street, Toronto, at a cost of $400,000. The building is to be two storeys high, with basement; 165 x 135 ft. in dimensions, of stone, steel and brick construction. The architect is Mr. C. S. Cobb, Toronto.

Work on the Toronto-Hamilton highway is being pushed ahead steadily. Last week fifteen men were added to the number of laborers employed at the Lorne Park section. During last week all who applied for work were given it. The wage paid is twenty cents an hour and the average day is eight and one-half hours. Difficulties with regard to the location of the line at different points are being adjusted.

It is expected that before long tenders will be called for interior fittings and furnishings for the new buildings now being erected at South Edmonton for the University of Alberta at a cost of $450,000. The architect is Mr. A. Burgess, who may be addressed at the University of Alberta, Edmonton. The general contractors are Messrs. Geo. A. Fuller Company, Limited.

At a meeting of the South Vancouver Council it was decided to donate $2,500 more towards the cost of preliminary surveys for the Fraser River Harbor Improvement scheme. The municipalities of Point Grey and Richmond will be asked to give a similar amount, which will be sufficient to complete the work. The plans have to be submitted to the Dominion Department of Public Works, Ottawa, by February 15.

Vancouver reports that no word has arrived from the Provincial Government concerning their stand in the matter of the proposed Second Narrows Bridge on which the Directors of the Burrard Inlet Tunnel & Bridge Company have been waiting for some time. It was stated last week that the information would be forthcoming immediately and consequently the Directors are anxiously awaiting word. A meeting will be held following the report of the Government and something definite decided upon. There is a probability that a new set of plans will be prepared and tenders invited upon them.

Good progress is being made on the warehouses and factory which Wm. Wrigley, Jr., Company, Limited, are erecting on Carlaw Avenue, Toronto, at a cost of $200,000. The architects are Messrs. Prack & Perrine, and the general contractors are Messrs. H. C. Christman Company, Hamilton. The building is to be five storeys high, with basement, the whole 92 x 262 ft. in dimensions, of reinforced concrete construction.

The seven-storey warehouse which Messrs. G. R. Gregg & Company are erecting on York Street, Toronto, at a cost of $120,000, is nearing completion, the trimming of the interior being now in progress. The building is of reinforced concrete construction and is being erected by Messrs. Alex. Shumway & Utz Company, of Rochester, N.Y., according to plans prepared by Messrs. Prack & Perrine, of Toronto and Hamilton.

Reduced Wages in the Building Trades at Montreal

THE Montreal Builders' Exchange, by the adoption of a lower scale of wages, has taken a drastic step to meet the situation arising from the lack of contracts and the conflicting scale of wages now in force. It is hoped that the measure will give more stability to the business, and that with the reduced cost of construction additional work will be available in the coming season. The supply houses are willing to accept lower prices for materials, while many contractors will take jobs on a slender margin of profit. The new rate will put firms on an equality in framing tenders, and will result in the disappearance of a disturbing element in the shape of variations of scales paid by different contractors, who were thus never certain as to the wages which were to be paid by competitors.

The prices agreed upon to be in force from January 1st to July 1st, 1915, as the maximum wages in the various trades are as follows:

Trade	New rate	Old rate
Bricklayers	40c	55c
Masons	40c	50c
Plasterers	40c	60c
Tile setters	40c	40c
Painters	30c	35c
Carpenters	30c	45c
Concrete framers	30c	45c to 50c
Building laborers	20c	25c

Apart from the above trades, it was agreed that wages in other sections will be reduced on an average of 20 per cent. below the summer scale. It was claimed that these rates, while under the union scale, were from five to ten cents an hour higher than men in the various trades were actually working for. Under existing circumstances it was found impossible to fix a minimum wage.

The Exchange also decided not to negotiate further with the Bricklayers' Union, and declared that so far as the members of the Exchange were concerned, "open shop" would be the rule in future in the brick and masonry trades. The Union claim that they have an agreement with the General Contractors' Association, but as the latter is a separate organization the Exchange does not consider this agreement binding on its members.

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Would the Licensing of Engineers Raise Their Professional Status?

ON another page we publish copious extracts from a paper presented recently before the Victoria and Vancouver Branches of the Canadian Society of Civil Engineers, by Mr. G. R. G. Conway, Chairman of the Vancouver Branch of that body and Chief Engineer of the British Columbia Electric Railway. Mr. Conway deals with matters of vital interest to the profession and his observations call for editorial consideration.

The ultimate purpose of raising the status of the engineering profession in Canada and placing it on the same plane as the Institution of Civil Engineers of Great Britain is one with which we are all in sympathy. Opinion is unanimous that there is room for a finer definition of engineering and a more generous recognition of its professional worth by government and municipal authorities. The Canadian Society of Civil Engineers has ample scope for further activity.

Passing over a number of interesting topics which a perusal of Mr. Conway's address discloses, we come to the question of licensing. It is not a matter for great surprise that Mr. Conway dismisses this question as one not of vital interest at the present time, and yet this view appears a trifle inconsistent with giving so many details concerning the movement in Pennsylvania, where a commission has been appointed by the Government, and in New York, where enactments looking to the licensing of engineers have been drafted and introduced into the Legislature.

Those who are opposed to the registration of engineers hold that by such means the public would secure no additional protection against the professionally inefficient. They cite the legal and medical professions as providing thousands of "fakes" who manage to pass the required test.

Personally, we hold some sympathy with this view, for we are thoroughly persuaded that in general the civil engineer is a more wholesome man—and a better man professionally, physically and morally—than either the lawyer or the doctor. But the fact remains that the legal and medical professions enjoy a higher professional status. Why is this? Does not registration provide at least a part of the reason?

It is adduced in all seriousness that one of the most aggravating difficulties in the way of enforcing a licensing bill is to determine the character of the examination. Concerning such examination, our esteemed contemporary, the Engineering Record, says in a recent editorial:

> "It must necessarily be sufficiently elementary to allow comparative newcomers in the profession to pass, yet such an examination is not a criterion as to the ability of a man to design a large structure, in which the hazard to life and property is much greater than any work that would be entrusted to a man who could barely pass the stated examination."

We might advance the same argument in regard to surgery. A "comparative newcomer" might know how to perform such a "simple" operation as lopping off a limb. Such knowledge might go a considerable way in passing him into his profession. And why not? The rest will depend upon the experience and reputation that he may bring to bear later. Only if he acquires name and fame will he be entrusted with those intricate, delicate touches of the surgeon's knife which hold the secrets of life and death. It is not to say that because he never attains to the highest proficiency in his profession that he is unqualified to render excellent service in it.

Is it not reasonable to apply the essence of this argument to engineering? Is it possible that the requirements would have to be so elementary that they would not act as an effective bar to admitting to the profession men incapable of observing those fundamentals of their work which, after all, reduce to a minimum the "hazard of life and property."

It is held that the wisest course for engineers to pursue is to direct their efforts to securing legislation making for the examination of engineering work rather than the examination of the engineer. This seems like putting the cart before the horse. If it were possible to work such a theory back to the beginning of all engineering undertakings, where would it find us?

Our illustrations may be slightly exaggerated, but they point our objections. We have an open mind on the question of licensing, and perhaps we should not presume to pass any criticism upon the views advanced by Mr. Conway and other progressive British Columbians who have been striving their utmost during recent years to place the profession upon a higher plane. But our criticism is intended to be nothing if not constructive, and our only excuse for the views we have advanced is that such generalities may stimulate readers of this journal to a discussion which could not fail to be illuminating and helpful.

Proposed Government Elevator, Vancouver. Estimated cost, $1,750,000.

Proposed Government Elevator, Vancouver

THE illustration on this page is of the proposed Government elevator which is to be built at Vancouver at a cost of $1,750,000. The buildings will be of reinforced concrete construction. The contract for the work was awarded recently to the Barnett McQueen Company, of Fort William, Ont., and preliminary operations are to be started at once. The capacity of the elevator will be 1,300,000 bushels. The site is at the shore end of the Government dock now in course of construction on the south shore of Burrard Inlet.

A new species of engineer is reported from England, where a firm advertises in the London "Times" as "Laundry and Cooking Engineers." What is doubtless meant is that the firm in question specializes in the design and installation of machinery for use in laundry and large culinary establishments, in hospitals, hotels, etc. There is no apparent reason, comments Engineering News, why the design and installation of such machinery is not as legitimate a field for an engineer's expert services as the design of machinery for power development or for cutting metal, but it is doubtful whether in this country, at least, such designers and constructors have risen to the dignity of separate nomenclature.

Record Tunnelling at Rogers' Pass

A new American rock tunnelling record—817 ft. in 30 days from November 1 to 30—was made in the Rogers' Pass tunnel of the Canadian Pacific Railway at Glacier, B.C. For the following information we are indebted to the Engineering Record.

The heading, 7 ft. 6 in. x 10 ft. in section, was driven through slate, containing quartzite bands, by a gang consisting of 3 drill-runners, 2 drill helpers, 8 muckers, 1 trackman, 1 pumpman, and 1 walking foreman for two headings. The grade was a 1 per cent. slope downward and the haulage was done by mules. A pump had to be placed at the face of the heading before dropping the drill bar for the lifter holes. This bar was 9 ft. 6 in. long and carried three Ingersoll-Rand water Leyner drills.

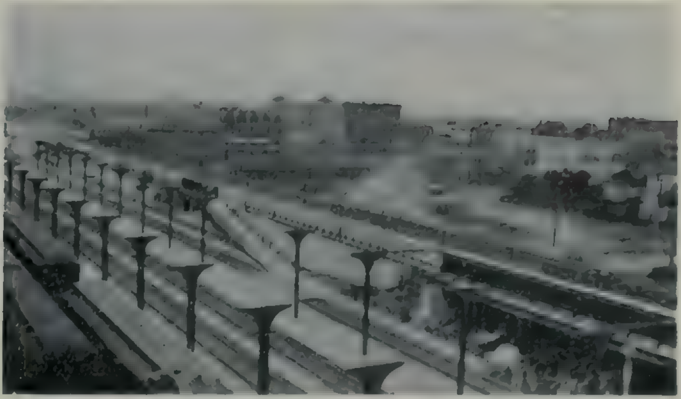
After the machine men had finished drilling the top holes of the heading and were waiting for the muck to be cleared away before dropping the bar to drill the lifter holes, they would oil their machines and connect up the air and water lines so that they could start drilling 1½ min. after the bar had been placed in its new position.

Shooting was done four times in 24 hours on 12 days, five times in 24 on 16 days, and six times in 24 hours on 2 days. The record round was 3 hr. 40 min. Two complete rounds were fired in 8 hours on November 27 and 28. The record day's work was 37 ft. on November 27. The record week's work was 220 ft. from November 23 to 29.

While the record of 817 ft. in a month was made in November that month contained only 30 days. Including December 1 a record of 852 ft. was made for 31 days. The contractors were Messrs. Foley Bros., Welch & Stewart.

The following men were in charge of the work: A. C. Dennis, superintendent; J. Fowler, assistant superintendent; W. Fowler and J. Young, walking foremen; D. Hamer, J. Stewart and A. Adams, shift foremen.

Track elevation work, Winnipeg. The dismantling of the old train shed.



General view of track elevation work at Winnipeg.

C. P. R. Improvements at Winnipeg

EXTENSIVE alterations are being made to the C. P. R. Station and Hotel at Winnipeg. The system of entering the train shed is entirely changed, the tracks are being elevated, and a large addition to the hotel—including a new ball room and new dining rooms—is practically completed.

There is now a concrete floor beneath the tracks and a number of stairways communicate with the various platforms. The concrete walks between the new tracks are covered by a gabled roof of steel. The new baggage room will be located at the north side of the station property, beneath the tracks, and a system of elevators will be installed for raising the baggage trucks. A subway is being built beneath the tracks at the east end of the station. This subway will be an extension of Maple Street, and will give admission to the baggage rooms.

Work is still proceeding on the new Main street subway. Our correspondent reports that the contractor "has had his work cut out breaking up the concrete." He writes: "This structure was so strong that the concrete mixture must have been in perfect proportions. At times the rock in the mixture would give way before the cement could be broken." Seven tracks and part of an eighth will cross the new subway. The first illustration shows the dismantling of the old train shed, and the second, track elevation work in progress.

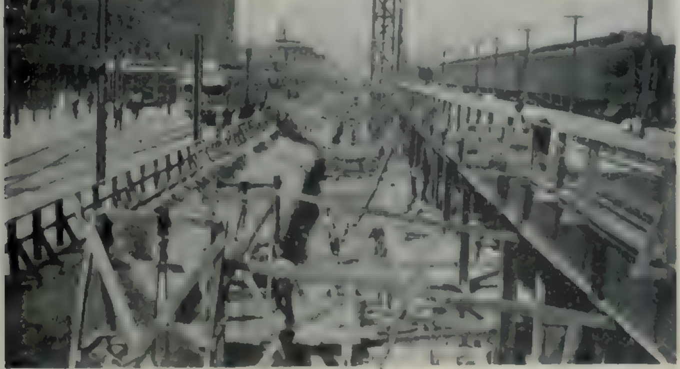
The railway tracks were elevated six feet in order to allow sufficient head room under the supporting structure. Plate No. 2 shows three under-track constructions in progress.

Plate No. 3 gives an idea of the track elevation. The lower track is seen on the left, and the elevated new track on the right. The buildings at the left are the C. P. R. station and the Royal Alexandra Hotel. It will be noticed in the picture that work is in progress on the concreting mat for the column footings.

The alterations to the Royal Alexandra Hotel have been on a most extensive scale. On the east side of the building a 175-room addition has been made. The fourth illustration conveys an idea of the character and extent of the work.

The interior arrangements have undergone a transformation. The telephone booths, etc., in the Rotunda have been transferred to another part of the floor, and the space is now occupied by handsome lounges. The new addition provides a spacious ball room, dining rooms and cafe. These are all located at the north end of the building. The ball room is approached by broad marble steps. On either side of the room there is a series of high arched windows, these giving the effect of dignity and space. The walls and ceiling decorations reflect skilled plastering art; hand painting will enter into further mural decorations. The whole room will be lighted by large glass chandeliers.

The walls and ceiling of the banquet room are panelled in fumed oak. The dining rooms, by an ingenious combination of sliding doors, may be enlarged as required.



Concreting mat for column footings at Winnipeg, in the third stage of track elevation work.

Constructional view of the addition to the Royal Alexandra Hotel.

Engineering Features of the Jordan River Power Development[*]

On Vancouver Island, about thirty-six miles west of Victoria, there is located what is known as the Jordan River Power Development. This development is owned and operated by the Vancouver Island Power Company, a subsidiary concern of the British Columbia Electric Railway Company, which is the principal public service corporation of Victoria.

During the last two years several articles describing parts of this development have been published in engineering journals, but there has been no complete description of the whole undertaking, and it is the object of this paper to give a fairly full description of the development, together with a brief history of the work. Although the Jordan River Development is small as compared with many modern plants, it includes a variety of engineering work not common to even those developments of much greater magnitude, and it is believed that the more important features will prove of interest to many engineers. This development possesses another point of interest in that it is—so far as the writer has been able to learn—the highest head development of any considerable size in Canada.

Historical Data

The growth and expansion of the districts in and around Victoria, which are dependent wholly on the British Columbia Electric Railway Company for street railway service, light, and power, have been phenomenal, and the demand for electrical energy has been doubled and re-doubled several times within the past seven years. In 1907 power was being furnished by a 2,000 kw. hydro-electric plant at Goldstream and an 800 kw. steam plant in Victoria, but it was realized at that time that a material increase would be required in order to meet the demands of the near future. It was decided, therefore, to look into the available water-power possibilities within a radius of commercially feasible power transmission to the city of Victoria. This investigation was continued for over a year, and practically all of the sources of water power around Victoria were examined. The exploration was carried on only under exceptional difficulties. Within a very short distance of Victoria the country was practically unmapped and unexplored. The mountains and valleys are densely covered with a growth of heavy timber, both standing and fallen, and the underbrush is of such a nature as to make it almost impenetrable. These conditions can only be properly appreciated by those who have experienced them.

The preliminary surveys of Jordan River were started the latter part of 1907, but on account of the winter setting in, it was impossible to finish this work until the following summer. A gauging station was, however, established near the mouth of the river and a series of records of rainfall and runoff were started.

In October, 1909, a party of engineers and a few workmen landed near the mouth of the Jordan River and established a temporary camp. This camp was used as a base while other camps of a more permanent nature were being built, and in a very short time construction work was started all along the line.

The original installation was completed early in 1912, but in the meantime the demand for power had increased so rapidly that work was started immediately on the installation of the second unit in the power house. This unit was put into operation in the fall of 1912, but the steadily increasing demand for electrical energy made it quite evident that still further extensions were necessary in order to keep abreast of the demand. The installation of the second unit marked the ultimate capacity of the initial development, and it was necessary, therefore, before making further additions to the power house, to increase the storage capacity of the system, enlarge the flume, and install about two miles of pressure pipe line between the forebay reservoir and the power house. The storage increase was obtained by the construction of the Jordan River dam, which was started in the summer of 1912 and in the spring of 1913 the construction of the addition to the power house was started. The flume and pipe line construction followed soon after, and the work was completed in October, 1914.

The Jordan River

The Jordan River flows into the Strait of Juan de Fuca at a point thirty-seven miles west of Victoria. The direction of flow is roughly from north to south, but the actual course of the stream is very tortuous. It is a typical mountain stream flowing in a deep and precipitous valley, and the fall is rapid from the source of the mouth. The source of the main river is in Jordan Meadows, which lie about midway between the east and west coasts of the Island, and at an elevation of about 1,700 feet above sea level. Several large creeks join the river within the upper ten miles of its course, the principal ones being Bear Creek, Wye Creek and Alligator Creek. The total drainage area is about 75 square miles, the greater part of which lies at an elevation of over 1,200 feet above sea level, and this entire area is covered by a growth of heavy timber.

The precipitation is heavy, probably averaging about 90 inches per year over the whole watershed. During the winter months there is a heavy fall of snow varying from 4 to 11 feet in depth in the higher parts. This snow, protected by the heavy timber and underbrush, often remains on the ground until well on in June or July, thus forming a splendid natural reservoir.

The total reservoir capacity of the system is 2,651,000,000 cubic feet which is divided among five reservoir sites as follows:—

Height of Dam	Location	Capacity Cu. Ft.
75 ft.	Bear Creek	607,000,000
125 ft.	Jordan River (Diversion point)	612,000,000
50 ft.	Jordan Meadows	980,000,000
50 ft.	Alligator Meadows	352,000,000
35 ft.	Wye Lake	110,000,000
	Total	2,651,000,000

At the present time only two of these reservoirs have been developed. A 57-foot dam impounds the water in Bear Creek creating a storage of 328,000,000 cubic feet, but this dam can be raised to the full height of 75 feet, when necessary, and the storage nearly doubled. The reservoir at the diversion point on Jordan River is developed to its full capacity. These two reservoirs provide a storage capacity of 940,000,000 cubic feet, which is sufficient for all present requirements.

General Plan of Development

The power house is located on the beach near the mouth of the river the centres of the water wheel nozzles being only a few feet above extreme high tide. Water is conveyed to the wheels from the forebay reservoir through steel pressure pipe lines about 9,300 feet long. The forebay, which is a small equalizing reservoir formed by two earth fill dams, is 1,152 feet above sea level, giving a static head of 1,145 feet at the power house. Water is carried from the diversion point to the forebay reservoir in a wooden flume about 5.3 miles long, built along the east side of the Jordan River valley. A small dam in Alligator Creek diverts the water from that creek into a small flume which joins the main flume about a mile below the main diversion point on Jordan River. Wye Creek joins the river above the diversion dam. Bear Creek flows into the Jordan River about 3.5 miles above the main diversion dam, and the Bear Creek storage dam lies near the headwaters of that creek and about a mile above its junction with the Jordan River.

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[*] From a paper read by the Superintendent, Mr. C. A. Lee, at a recent meeting of the Vancouver Branch of the Canadian Society of Civil Engineers.

Transportation

One of the most serious problems connected with a development of this kind is that of designing and organizing an efficient transportation system. The distances are comparatively great, many of the grades are heavy, and the country through which the roads must be run is rough and heavily timbered.

Victoria is the nearest shipping point to Jordan River, and as there is no railroad connection between the two places it has been necessary to transport all freight by water. This method of transportation presents many difficulties on account of the unprotected nature of the coast, the rough water often encountered, and the lack of any harbor at Jordan River. At the time the work was started there was a government built road to within nine miles of the power house site. Although this road has since been extended to Jordan River, it does not offer a practical means of transportating large quantities of heavy freight and has only been used to a limited degree for passenger travel and emergency transportation. The transmission line material was distributed by means of this road.

All freight has been transported from Victoria on 60-ton scows towed by a powerful and seaworthy tug owned by the company. The water at Jordan River is too shallow to allow the tug to bring the scow to the wharf, so the tow lines are run ashore and the scow is pulled alongside the wharf by hand and there unloaded by a steam derrick.

At the wharf the freight is loaded on to double truck 3-ft. gauge cars, which are hauled by horses about a quarter of a mile to the foot of an inclined cable tramway. Here the cars are made fast to a ¾-inch plow steel cable and hauled up to the forebay reservoir, a distance of approximately 9,500 feet. The total rise in this distance is 1,125 feet and the maximum grade is 48 per cent. The cable is operated by a steam winding engine with 12-inch by 12-inch cylinders and the drum has a capacity of 10,500 feet of ¾-inch line. On account of several comparatively level portions along the road, the empty car will not overhaul with the heavy cable dragging behind, so another winding engine is placed at the lower end of the line and hauls the car back by a ½-inch cable. This lower engine is driven by a variable speed induction motor of 50 h.p. The haulage lines are supported on sheaves or rollers placed between the rails, and there is very little wear on the rope. This tramway parallels the pressure pipe lines, so that it has not been necessary to build other tracks or roads for laying the pipes. Loads of five tons and under are hauled on a single line, but heavier loads are blocked over the steepest grade. It requires about thirty-five minutes to make the round trip and as many as eighteen trips have been made in a ten-hour day.

Power house, showing completed building and tail race.

At the end of the tramway a small hand operated stiff-leg derrick is located, by means of this the loads are transferred to single or double truck cars to be hauled over the flume railroad.

The flume railroad parallels the flume for its entire length of 5.3 miles and is on a grade about fifteen feet above that of the flume. This road is also three-foot gauge and is built of 20-pound rails, as are all the other roads on the transportation system. The writer believes this to be about the "crookedest" piece of railroad in the world, there being practically no tangent and many of the curves being as sharp as 90 degrees. There are many short bridges and trestles along the line where it crosses small creeks, and it is built for almost its entire length along the steep hillside. The cars are drawn by horses or by a small saddle tank locomotive. The locomotive has been made into an oil burner to guard against fire.

During a part of each winter the flume railroad is put out of commission by the deep snow. This has made the transportation to the upper camps very difficult. During this time it is practically impossible to haul any heavy freight, but camp provisions have been carried on horse-drawn sleighs along the railroad tracks.

From the end of the flume railroad at the main diversion dam a wagon road continues for about 4.5 miles to the Bear Creek dam site.

Bear Creek Dam

The Bear Creek Dam is built at a point about a mile above the junction of Bear Creek and Jordan River. The water is backed up the narrow valley for about two miles above the dam and forms a lake which at high water level, with the water surface five feet below the dam crest, has an area of 285 acres and provides storage for about 328,000,000 cubic feet of water. The drainage area above the dam is 8 square miles in extent and rises to an elevation of over 2,000 feet above sea level.

The dam is an earth embankment built by the hydraulic process. The greatest height above the bottom of the valley is 57 feet and the length on the whole is 1,020 feet. The crest has a width of fifteen feet, the downstream slope is 2½ to 1 and the upstream slope is 3 to 1. The spillway is excavated from the solid bedrock at the north end of the dam. The volume of the dam, as measured in the embankment, is 148,000 cubic yards.

In order to assure watertightness and provide a secure foundation, not only for the initial structure 57 ft. high, but for an ultimate structure 87 ft. high for developing the reservoir to its ultimate capacity, it was decided to drive steel sheet-piling to bedrock, thus forming a curtain wall across the valley.

Bear Creek storage dam.

Interlocking 12-inch 40-lb. Carnegie steel sheet piling was driven in the bottom of the trench to bedrock by two pile drivers with 2,000 lb. drop hammers. The piling was furnished in lengths of 50 ft. and less. The driving was hard on the north end of the dam, but all piles were driven until bedrock was reached, as indicated by the testholes. The piles were cut off at a height of from 4 to 6 feet above the bottom of the trench and the trench was thoroughly cleaned out before sluicing was started. The total yardage excavated from the trench was 8,700 cubic yards. This material was piled about 15 ft. from the downstream edge of the trench and is included in the dam just below the puddle core. A total of 28,500 feet of sheet piling was driven to form the curtain.

The filling of the dam was started in September, 1911. Owing to the necessity of completing the work in time to store water for the 1912 dry season, it was considered advisable to provide a steam pumping plant to preclude, as far as possible, interruptions in sluicing due to the failure of the gravity supply. A steam pumping plant was therefore installed. This consisted of two 6-in. belt-driven centrifugal pumps having a capacity of 1,000 gals. per minute each, against a head of 250 feet. The boiler plant consisted of three 50 h.p. boilers using wood as fuel.

The quantity of water used in sluicing varied from 3 to 5 cubic feet per second and was discharged through 3-in. or 4-in. nozzles. It was not attempted to break up the ground, which was largely hardpan, with the jets, but powder was used throughout the job, the holes being gophered for 10 to 16 feet into the base of the bank along the surface of the bedrock. This use of powder broke the ground nicely and made it easy for the monitors.

Of the total volume of the dam 134,405 cubic yards of material was placed by sluicing. This work was done in 3,718 hours of actual sluicing, or an average of 870 cubic yards placed per 24 hours. The average quantity of water used was 4.5 cubic feet per second, and the average proportion of solids to the water used was 6.3 per cent.

The construction of the dam was started in November, 1910, and the work was completed in April, 1912. Since that time the dam has been in service and its behavior has been entirely satisfactory. Measuring weirs were built at several points below the dam to record the leakage, which was found to be so slight as to be almost negligible.

Shortly after the completion of the dam, and before the fill had drained out, the weirs showed 0.19 cubic feet per second, but this has since decreased to less than 0.1 cubic feet per second. There has been no appreciable settlement of the fill.

The undertaking to raise the height of this dam to 75 feet should be comparatively simple, as a safe foundation is provided and most of the perplexing and expensive features of the construction are solved. An extra 20 feet in height will nearly double the capacity of the reservoir.

The Jordan River Dam

Immediately below the junction of Wye Creek and Jordan River the canyon narrows and is crossed by a ridge of bedrock which extends well up on both sides of the canyon and across a fall on the east side of the river. This site was recognized as the best for a concrete or masonry dam of a permanent character. It was originally intended to place the diversion dam at this point, but owing to the limited time, the lack of a ready supply of concrete material near the site, and also in view of the probability of using the site at some future time for the construction of a high dam which would, in addition to diverting the stream into the flume, form a large reservoir, another location was chosen for the temporary diversion dam about 2,000 feet further up stream. In order to utilize the runoff from Wye Creek, a small diversion dam was also built on this creek and a branch flume was built to carry the water from this dam to the main flume on the east bank of the river.

The temporary Jordan River diversion dam was a substantially built rock-filled log crib sheeted with two thicknesses of 2-inch planks. It was founded on bedrock and the bottom edge of the upstream sheeting was set in a concrete sill. The length of the crest was 128 feet and the width 8 feet. Both faces were built on 1 to 1 slopes and the maximum height was 18 feet above bedrock. The flume intake was located at the east end of the dam and was also constructed as a rock-filled crib and line with two layers of 2-inch plank. The regulation of the flow of water was controlled by three timber headgates operated by rack and pinion. These gates discharged directly into an intake basin depressed two feet below the floor of the flume and provided with sand gates through which the silt and sand which might collect in the basin could be discharged.

The Wye Creek dam was of similar construction, but the crest length was only 90 feet.

These two temporary dams were completed during the summer of 1911 and gave satisfactory service until they were replaced by a permanent structure built on the site which had originally been chosen for the diverting dam.

The storage provided by the Bear Creek reservoir was sufficient to supply the demands of the original power plant, but on account of the rapidly increasing demand for power is became necessary to increase the power house capacity and also provide greater storage. The increase of storage capacity could have been provided by developing any one of several reservoir sites, or by raising the Bear Creek dam, but the development of a rservoir at the diversion point offered advantages over any of the other propositions and the decision was made in favor of this site.

The choice of the type of dam for impounding the reservoir lay between a gravity type concrete or masonry dam and a hollow reinforced concrete dam of the Ambursen type. Test pits were sunk along the proposed centre line of the dam and bedrock was struck at depths varying from nothing to 18 feet below the surface, the average depth being 8 feet. This foundation was suitable to either type. The quantity of material required for building the structure, however, was much in favor of the hollow type dam. Time was also an important consideration, for it was very desirous of storing a good part of the 1913 spring runoff. Under these conditions the hollow dam was considered most suitable, and in August, 1912, the construction of this dam was started.

The reservoir is formed in the narrow Jordan River valley, but the water is also backed up into the Bear Creek and Wye Creek valleys, thus forming a lake slightly over three miles in length and having an area of 398 acres at the spillway level. The capacity of the reservoir above the outlet gates is 612,000,000 cubic feet.

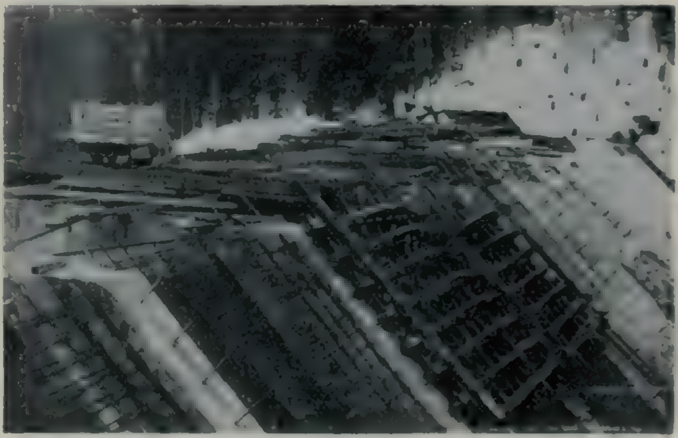
At the dam site the sides of the valley slope up rapidly from the river, but at a height of about 70 feet the east bank flattens out and the slope is gradual back to the base of the hill. The crest of the dam is 891 feet in length, of which 130 feet is earth embankment with a concrete core-wall. The spillway is located near the east end of the dam. It is 305 feet in length and the crest is 8 ft. below the top of the dam, providing for a flood discharge of 23,000 cubic feet per second. The curved crest and rollway apron discharge the water clear of the toe of the dam and into a natural channel across the flat. This channel joins the river about 200 ft. below the dam. The extreme height of the dam is 126 ft. from the deepest part of the buttress foundations in the river bed to the crest. This is believed to be the highest dam in Canada, and it is the next highest Ambursen type dam built at this time.

In preparing for the foundation the whole area to be occupied by the base of the dam was not stripped to bedrock, but only those portions to be occupied by the buttresses and the cut-off trench. Trenches were excavated along these lines and all loose rock was removed and the bedrock carefully cleaned before placing any concrete. Wherever necessary the surface of the bedrock was roughened by blasting, or a shallow trench was excavated in the rock to provide a good bond for the concrete and guard against possible slipping. The cut-off trench, which was excavated along the upstream toe of the dam, varies in depth from 3 to 12 feet, depending upon the condition of the rock. In all cases it was carried to a sufficient depth to assure watertightness.

The dam consists of a reinforced concrete face or deck inclined at an angle of 45 degrees and supported on concrete buttresses which are spaced 18 feet centre to centre across the whole length of the dam. These buttresses are 12 inches thick at the top and increase, by steps or lifts 12 feet high, to 42 inches in thickness at the bottom of the highest buttress. The upstream edge is built on a slope of 1 to 1; the downstream edge has a batter of 1 to 4 to a point 18 feet below the crest, from which point it is vertical to the crest. Just back of the upstream edge a heavy reinforced haunch or shoulder is built on either side of the buttress and the decks are supported on these haunches. The buttress projects beyond the haunches a distance equal to the thickness of the deck. A bonding groove or key is cast in this projection. No vertical reinforcement is used in the buttresses excepting along the downstream edge and in the haunches, which are heavily reinforced to carry the decks. Horizontal reinforcement is used along the top and bottom of each of the 12-foot lifts or steps. Horizontal columns, or tie beams, which are reinforced top and bottom, connect the buttresses at various elevations and give them lateral support. The reinforcement in these beams is continuous through each three consecutive buttresses but is not carried continuously through the dam on account of possible strains set up by expansion and contraction.

Only two sizes of reinforcing steel were used in the entire dam, these being ⅞ in. and ⅝ in. square corrugated bars. Seven-eighth inch bars were specified for all of the main reinforcement. The ⅝ in. bars were used only for hooks and vertical reinforcement. The total weight of steel used in the dam was 380 tons.

Practically all the material in the dam was handled by a cableway spanning the valley on the centre lines of the dam. The length of the span was 920 feet. The standing line was 2¼ in. in diameter. On this a heavily built carriage was operated by a 2-spool cable engine. In placing the concrete the cableway brought the bucket over hopper-bottom cars which were pushed by hand along tracks laid on top of the buttress forms. These tracks were made up in sections about 12 ft. long, with platforms 3 ft. wide on each side of the rails. The space between the rails was not floored over so that the car could be emptied into the buttress form as it was pushed along the track. The car body was mounted on the trucks as a turntable and the spout could be turned in any direction. The track sections were secured to the buttress forms by means of chains with turnbuckles. The concrete was dumped from the bucket into the car and was then distributed in the buttress form or through chutes into the deck forms. Men worked in the forms and the concrete was carefully puddled as it was dumped. Shovels were used for puddling and no tamping was done. Forms, scaffolds and reinforcing steel were also placed by means of the cableway.


Jordan River dam, showing details of deck construction.

The construction work was carried on right through the winter, all work being confined to those parts of the dam on both sides of the river above high water level. This was only done under great disadvantage, as the winter was particularly severe, there being a depth of over 6 ft. of snow on the level at one time, and the ground was well covered until well on in May. The cost of clearing away the snow was a considerable item, and much time was lost. During the winter all sand and water used in the concrete was heated by steam, but no further precautions were taken, and no trouble was experienced due to the freezing of the concrete in the forms.

The deep snow made transportation over the railroad impossible excepting in horse-drawn sleighs. This condition was, of course, foreseen, and 75,000 sacks of cement were stored in the sheds at the dam site before winter set in. This was a sufficient supply to last until the railroad was opened in the spring. Only the necessary camp supplies were transported over the snow.

With the exception of the cableway engine and the derrick engines, all plant used in the construction of the dam was operated by electric motors. A transmission line 7½ miles long, built on the pipe line right-of-way and the flume right-of-way from the power house to the dam site, furnished current at 6600 volts. This voltage was stepped down in a sub-station at the dam site to 2200 volts, the large motors operating at this voltage, and it was further reduced to 220 and 110 volts for the small motors and the lighting circuits.

All cement used in the dam was manufactured in British Columbia. A laboratory was fitted up at the dam and the usual physical tests were made on all cement as it was received. Tests were also made by an outside laboratory not connected with the work in any way. Each lot of 1,000 sacks was separately sampled for the two sets of tests. No cement was used unless both tests showed favorable results. Boiling or accelerated tests on the cement to be used the following day were made each day in the field laboratory. Compression tests were made on 6-in. cubes of concrete which were cast from the concrete as it was being placed in the buttresses, representing the material actually in the dam. The results of these tests were satisfactory. In building the dam 132,000 sacks of cement were used.

Jordan River dam. The completed structure. Water passing over the spillway, March 28, 1914.

All lumber used in the construction of the dam for form work, scaffolds, camp buildings, etc., was sawn in the company's mill—located at the lower end of the flume. This lumber was transported to the dam site over the flume railroad. The total quantity of lumber used was 1,200,000 ft. B.M.

Main Flume

The main flume follows the east side of the Jordan River valley from the Jordan River dam to the forestry reservoir, a distance of 5.3 miles. The side of the valley is steep for the entire distance and is broken by frequent precipices and deep indentations. As a rule the formation is suitable for the flume foundations, rock or hardpan lying only a foot or so under the surface, but in a few places it was rather difficult to get a secure footing.

The flume is built entirely of timber, and was designed for an ultimate carrying capacity of 175 cubic feet per second. The box is 6 ft. by 6 ft. in section, allowing for a depth of 5 ft. 6 in. of water, and has a grade of 1 ft. in 1,000 ft. As originally built the box was only boarded up to a depth sufficient to carry 75 cu. ft. per sec., and was supported on bents placed 15 ft. centre to centre. During the summer of 1913 the box was completed to its maximum capacity. In order to support the additional weight of water, it was necessary to erect intermediate trestle bents, making the bents 7 ft. 6 in. centre to centre.

The railroad which parallels the flume for its entire length, greatly facilitated the work, as all lumber and other construction materials could be delivered at the points at which they were to be used.

Five gates are provided along the length of the flume. These are set in short boxes formed by dropping the floor of the flume about three feet below grade, and serve to catch all sand and silt which may enter the flume. The gates may also be used to empty the flume quickly in case of emergency.

Nearly 5,000,000 ft. B.M. of lumber was used in the construction of the flume. This was all cut in the company's mill located at the lower end of the flume and adjacent to the forebay reservoir. Logs were procured from splendid timber limits near the mill, and were hauled to the mill over skid roads by steam logging engines. The mill was rated at 20,000 ft. per day, but by replacing the steam power by electric motors the capacity was greatly increased, as much as 45,000 ft. being turned out in a ten-hour day. Although the mill was built primarily to supply the flume lumber, all the lumber used on the job has been sawn in this mill. The total output to date is nearly 8,500,000 ft. B.M., all of which was used for construction work.

The flume has been in continuous service since its completion. There have been several short interruptions due to slides and falling timber. With a flume of this character it is only natural to expect some trouble, but the line is patrolled daily.

Forebay Reservoir

The flume discharges into the forebay reservoir, which is a small artificial lake formed in the comparatively flat saddle between two hills by two earth fill dams built across the valleys immediately to the north and south of the ridge. These dams, or embankments, were built of the material excavated from the higher ground lying between them, thus adding to this extent to the capacity of the reservoir. The capacity is 4,350,000 cubic feet.

The north dam has a length of 560 feet on the crest and contains 24,290 cubic yards of material. The south dam is 700 feet long and has a volume of 26,560 cubic yards. The slopes of both embankments are 2½ to 1 on the water side and 2 to 1 on the lower side. The maximum height of both dams is 35 feet.

Two 44-in. diam. rivetted steel pipes pass through the base of the south dam at the head of the pipe lines. From the core wall to the upper edge of the dam these pipes are embedded in concrete, but from the core wall to the lower toe they are in open culvert with a common centre wall and reinforced roof, thus insuring perfect drainage and allowing inspection. A concrete intake structure is built at the upper end of the pipes, and the control of water is obtained by means of two 54-in. diam. roller-bearing sluice gates, behind suitable trash racks. The gates are controlled from the top of a structural steel gate tower, which is connected with the crest of the dam by a light foot bridge.

An emergency spillway is built in the solid ground at the east end of the north dam, and any surplus water is here returned to the river, which flows in the valley about 400 ft. below the forebay level. The crest of the spillway is 5 ft. below the dam crests.

The function of the forebay is to increase the peak load capacity of the power house by providing storage immediately at the head of the pipe line, and also to furnish a reserve supply of water sufficient to operate the generating machinery for a few hours in case of accident to the flume.

Pipe Lines

The pressure pipe lines from the forebay to the power house are 9,290 feet long. They follow the general slope of the hill, and are laid in shallow trenches with the earth backfilled to form a cover over the pipe. There are numerous vertical bends of a few degrees each, as the slope of the hill side is not uniform, but there are no sumps or crests in any of the pipes. The lines are practically straight from the forebay to the power house, with only a slight horizontal bend near each end. In excavating the trenches for the pipes all surface soil was removed. The pipes are well supported on hardpan or gravel for their entire length. The space between the bottom of the pipe and the trench is tightly packed with small rocks and gravel. This serves to give uniform support over the entire length of the pipe and also forms a drain for seepage water. Concrete deflecting walls, built at intervals along the pipe, turn this water out of the trench and into natural drains along the hill.

No. 1 pipe is a lapwelded steel pipe varying in thickness from 5-16 in. at the wye to 9-16 in. at the power house. The joints between the sections are spherical "bump joints," with double or single rows of rivets, depending on the thickness of the steel. For 2,200 feet above the power house the pipe is banded with 1-in. steel bands having malleable cast iron shoes. This banding was considered necessary on account of possible severe rams in the pipe caused by quick governing.

No. 2 pipe is a heavy rivetted pipe made up of parallel outside and inside courses, the thickness varying from ½ in. at the wye to 1 in. at the power house. The longitudinal joints are provided with double cover plates, making a joint of about 78 per cent. efficiency. Although this pipe is ¼-in. greater in diameter than No. 1 pipe, the results obtained are not as good. The very rough interior surface of the pipe which results from the parallel courses and the numerous rivet heads, increases the friction in the pipe so that there is a considerable loss of head when the unit is loaded. The friction loss, or loss of head, is nearly 15 per cent. greater for No. 2 pipe than for No. 1.

Pipes No. 1 and 2 are each equipped with six air valves, about equally spaced along the lines. Each pipe has also three manhole openings, one located at the lower end, one at the wye pipe, and one half-way between these two. There is also a manhole in the 44-in. pipe just below the forebay. Pipeline No. 3 is provided with seven air valves equally spaced along the line, and the manhole openings are located 1,000 feet apart along the entire length of the pipe. This generous use of manholes was of great assistance in the erection of the pipe, the extra cost being more than compensated for by the time gained and the wages saved.

Connected with the installation of No. 3 pipe there are some experiences which may prove of interest. The erection of this pipe was started late in the summer of 1913, and the field work was finished early in January, 1914. On filling the pipe for the first time several leaks developed in the circumferential welded joints of the heavier pipes near the power house when the pressure was only a small fraction of the static head to which the pipes would be subjected when filled to the top. These leaks were repaired by rivetting heavy butt-straps around the pipe at the faulty welds, but on account of the possibility of other leaks developing and damaging the power house or the other pipe lines, it was decided not to fill No. 3 pipe until it had been tested and made safe against further failures.

It was planned to test the pipe in comparatively short sections, so that in case of failure the amount of water in the section under test would not be sufficient to do any damage. To make these tests a bulkhead was designed to fit in the pipe at the upper end of the section under test and to confine the water between that point and closed gates at the lower end of the pipe.

The bulkhead was made up of a dished steel casting about 2½ in. less in diameter than the internal diameter of the pipe. The circumference of this casting formed the base of a packing gland built up of steel rings which confined the packing. The packing consisted of two rings of 1 in. square hard steam packing, one on either side of a ring of rubber packing 1 in. thick and 2-in. wide. The back steel ring of the gland was provided with sixteen forged steel dogs which held the ring from moving up the pipe, the ends of the dogs resting against the end of the next section of pipe at a rivetted joint. The pressure of the water against the bulkhead compressed the packing by forcing the bulkhead or disc into the back ring of the gland, which, in turn, was held securely in place by the dogs, thus making a watertight joint. The whole contrivance was mounted on rollers to enable it to be moved along the pipe.

The pipe line was cut at the upper end of the welded portion of the pipe, and the bulkhead was lowered (by means of a light wire rope) to the upper end of the section to be tested first. Some trouble was experienced at first in setting up the bulkhead in the pipe, but after several unsuccessful attempts the pipe crew learned to overcome their difficulties and were able to make a tight joint.

The pipe was filled up to the bulkhead through a by-pass from one of the old lines, and the pressure was raised to the required test pressure by means of a large hand operated boiler test pump. The bulkhead was provided with an air valve to exhaust all air from the pipe and make sure that the space was entirely filled with water. A pressure gauge was attached to the pipe and in each test the pressure was raised by means of the pump at 35 per cent. in excess of the pressure due to the static head, this pressure being recorded at the lower end of the section under test. Before making the excess pressure test, each section was tested under static head by hammering along the welds with 3-lb. hammers.

So far as the writer has been able to learn, this is the first time a large high pressure pipe line has been tested in the field after erection. The results obtained at Jordan River would indicate the practicability of such a test, and it must be admitted that such a test is of great value in proving the pipe, not under shop conditions, but under actual working conditions. These tests suggest the use of a bulkhead, similar to the one used at Jordan River, in connection with the erection of almost any long pressure pipe line. By the use of such a bulkhead the pipe could be tested from the bottom as the work proceeded. It could be kept filled with water and the trench could be backfilled at once, thus avoiding the usual temperature stresses set up in such a pipe line.

The Pelton Water Wheel Company, who were the contractors for the pipe line, designed the bulkhead and made the tests on the pipe under the direction of the Vancouver Island Power Company's engineers.

Militia orders issued recently announce that Provisional Major Geo. Janin has been attached to the Divisional Engineers of the Second Canadian Expeditionary Force, with the following lieutenants: T. Noall, W. H. Brunning, K. C. H. Monks, A. Charlebois and A. O. Sullivan. Mr. Janin, who is well known as the chief municipal engineer of the city of Montreal, raised a company of two hundred engineers when the war broke out. Sixty members of the force have been connected with the civic service.

The Dominion Pulp Company, Limited, Chatham, N.B., are installing an induced draft system to furnish draft for their entire plant. This has been manufactured by the B. F. Sturtevant Company of Canada, Limited, Galt, Ont.

Memorial Church at Toronto which Embodies Good Constructional Practice

OF the later ecclesiastical buildings erected in Toronto, one of the most attractive from the standpoint of design and construction is the Timothy Eaton Memorial Church, which has been built on St. Clair Avenue by the Methodist body.

The building has a frontage of 238 ft. on St. Clair Avenue and a depth of 134 ft., and covers the entire area between Warren Road and Dunvegan Road. The church is monumental both externally and internally, yet it is essentially practical, providing as it does for the greatest possible comfort in the way of unobstructed sight and sound.

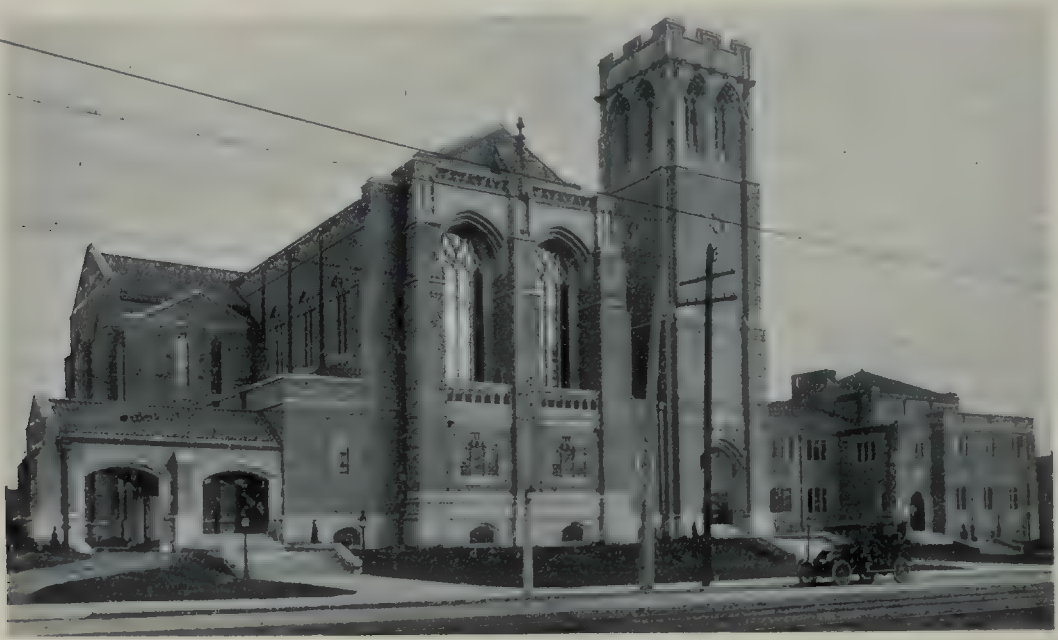
Built of grey Credit Valley stone and Indiana limestone, with elaborate cut stone decoration, the structure forms a handsome group of buildings. A unique feature of this building is the belfry tower, the apex of which stands about 100 ft. above the street level. A peal of twenty-one bells is at present being installed.

The style of architecture is that of the Late Decorative period, which is consistently followed in all the appurtenances, the object in the selection of these being to secure harmony with the building itself. A porte cochere affords a sheltered entrance, with ample protection from the west winds. The entrance doors of the church are reached by steps of Quebec granite.

The color scheme adopted for the interior is harmonious throughout, resulting in a delightfully warm effect. The decoration on the walls consists of an entire covering of metal leaf, over which colored glazes have been placed. The vestibules are designed with the object of affording the maximum space consistent with the architectural proportions of the church. They are finished in Caen-stone, the flooring being tile. An unusual feature is the beautiful Gothic Caen-stone mantle and fireplace which have been fitted. The woodwork throughout the building is quarter-cut white oak, fumed to a soft brown tone. Here and there it is richly traceried and cusped, the general effect being highly satisfactory. The board room or vestry has an enriched pendentive plaster ceiling, also a recess with fireplace and book cases done in Gothic traceried quarter-cut oak and cut stone.

Below the auditorium there is a spacious room decorated in light colors, adjoining which is the kitchen, fitted up with sinks, electric and gas stoves, pantry fittings, etc. The main room has been arranged for interior bowling as well as for banquets. Adjoining this room is a splendid bowling alley. There are also the usual toilet rooms which are tiled and decorated.

The building has been designed with a view to obtaining perfect acoustics. The ceiling has a 2-in. lining of solid felt, covered with repp instead of the usual plaster work. The pews, pulpit, pulpit chairs, communion tables, organ cases and the lighting fixtures were specially designed; even the table and envelope cases in the vestibules have been constructed so as to conform to the general scheme.


The Timothy Eaton Memorial Church, Toronto.

The lighting fixtures are somewhat unique. The supports are of bronze, while the fixtures themselves have been made to harmonize with the decorative frieze. They are constructed with delicate open traceried work, lined with silk. Through this a soft and pretty light is obtained, the real illumination of the building being reflected from the ceiling. These fixtures are so constructed that they can be lowered in a few minutes by means of powerful winches set above the ceiling.

Facing the audience is a memorial window to the late Timothy Eaton. The central portion of the window is a reproduction of "The Light of the World," by Holman Hunt. This window is said to be one of the finest in Canada. It was executed by the firm of Robert McCausland, Limited, Toronto. The windows, other than the memorial, are glazed with clear glass, and there are neutral colored hangings to each. This not only permits of the regulation of light but heightens the artistic effect of the whole.

The heating and ventilating equipments are of the most modern type. Air, warmed to an even temperature, is driven by a large fan into a space between the floor and the basement ceiling, access to the church being gained through openings in the floor beneath the pews. By this means an even and imperceptible distribution is obtained. Another large fan for exhaust purposes has been installed. Both the heating and ventilating systems are thermostatically controlled.

The architects were Messrs. Wickson & Gregg, Toronto. The following are the contractors: Mason work, Thomson Bros.; carpentry, Mr. E. MacKenzie; structural steel, Dominion Bridge Company; plumbing and heating, Messrs. Bennett & Wright; painting, etc., Messrs. W. J. Bolus Company; plastering, Mr. Henry Nelson, Toronto; roofing, Messrs. H. Williams & Company; electric wiring, Mr. George J. Beattie. The organ front, which is of English oak, was manufactured by the firm of H. H. Martin & Company, Limited, of Cheltenham, Eng. The bells are being supplied and erected by John Warner & Sons, London, Eng. The cut stone was supplied by Messrs. Nicholson, Curtis & Vick, and the granite by the Thomson Monument Company, Limited, Toronto.

Service Tests of Street Paving[*]

By H. W. Durham[†]

THE subject of tests for street pavement surfaces is much discussed at the present time—and to a great extent unintelligently. It is rehearsing a familiar tale to recount the reasons for the public interest in roads, but only in this country is the contrast between the present type and that of the past century so great. The settled countries of the Old World have always had good roads viewed in the light of the traffic that used them; the majority of ours have always been poor like those of all other countries of vast areas and sparse population.

The oft-cited Romans knew, and perhaps others before them, that the essential of a durable road was a solid foundation. Whether this be rubble, stone, concrete or an original unyielding ground is purely a local question, provided that in some way a rigid base is supplied for the surface on which the wheels are to roll and the feet to press. The first man who made sandals discovered that they wear. Removable iron tires were an invention partly designed to furnish wooden wheels with a renewable wearing surface. Our railroads find it difficult to keep up with rail renewals. And, yet, we still have a public, led by otherwise intelligent critics, clamoring for the perfect, permanent road surface.

The attempt to answer this demand has led to many extravagant claims and over-confident beliefs as to the possibilities to be attained in the way of final deductions from observation of a series of test pavements, or measurements of road wear and of the use of various testing machines. Valuable information has been and will be derived from all these sources, but not to the decisive extent supposed by many to be attainable. Much of the confusion of thought noticeable in all discussions on road matters is caused by inability to discriminate between cause and effect. We have developed a school of thought that would substitute records and reports for results and that is more interested in watching the accuracy with which the wheels of the machine move than whether a result is attained. It is well to remind this class that their ideal is best realized by a wheel spinning in a vacuum on frictionless bearings not affected by outside forces and doing no work whatever. It is the law of human experience, practical as well as scientific, that no result is attained without cost; that we get only "so much for so much"; and consequently the search for ideal specifications or tests is valueless if they are thought to lead to a means of building what an early generation, misled by considering that they had a non-wearing material, called a permanent way.

It is not before but after the statement of the true principles of paving construction that we can define proper tests. Just as we provide renewable shoes for men and horses, carpets for our floors, and rails on our steam road beds, so the correct modern pavement for town or country must have a repairable surface on a durable foundation, and our tests will fall in two classes—those for determining the best type or types of such surface, and those for recognizing the materials of which they should be composed. It is in regard to the former that a few words may be said here.

Broadly speaking, and assuming it to be conceded that the durable foundation must and will be provided, the present practice recognizes, as has been the case in the past, only two general classes of wearing surface: first, one composed of regular shaped rigid blocks of some durable material, laid so as to be virtually in contact and to form within the limits of variation of their own faces a smooth surface; and second, a pavement consisting of a more or less regular assortment of irregular fragments of some mineral material, also individually rigid but of graded sizes, so as in the mass to present a minimum of voids, held together by some cementing material and also laid on a foundation, the mass having a constant thickness and a smoothness of surface depending on the extent to which all voids are compactly filled. These definitions are not absolutely accurate, but they indicate broadly the only two methods that have ever been successfully followed for street pavements at any time. In the first class are all types of stone block ranging from the heavy square stone pavements still successfully used in Italy and Austria, which are a direct inheritance from the Roman methods, down to the modern German mosaic or kleinpflaster road, which attempts to produce smoothness without accurate dressing of the blocks by reducing their size to a minimum. It also includes all types of wood block pavement as well as brick in all its variations. The second class includes the original dirt road surface and grades from that up through the improved methods of Macadam, Telford and Tresauguet to the modern asphalt and bituminous concrete pavement.

Leaving out of consideration the tests by which it is determined whether the materials for any bit of construction are in conformity with specifications, the true test on which a choice of suitable wearing surface for a road is made is that of service, and by service it must be understood to mean the actual service which the road in question is to undergo. Reference has already been made to the construction of so-called test sections of road. The idea has been that by constructing along a selected bit of road a series of short sections of many different types some definite determination could be made as to their relative advantages and wearing qualities. On the face of it the scheme seems very plausible. Notable among such experimental sections is that on the road to Sidcup in London, the test sections in Philadelphia and the experimental stretch on Second Avenue, New York. While these experiments have a limited value, it cannot be said that the method furnishes a final authoritative test of the types of surface adopted.

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[*] Presented before Section D of the American Association for the Advancement of Science, at the Philadelphia meeting, December 30-31, 1914

[†] Chief Engineer in Charge of Highways, Borough of Manhattan, New York City.

A road or a street, whatever its length, is more or less of a unit. It can not be considered as composed of short links. It is impossible to be certain that test conditions are the same for all the samples tested, and particularly in the construction of each one that conditions are fair to all and that each sample is the best of its type. Again, certain forms of construction which are eminently suitable for certain locations and under certain conditions of traffic are distinctly the reverse in other places and, consequently, the failure of any one test section, while demonstrating nothing except that it has not lasted under the specific conditions to which it has been exposed, may bring it into unfair comparison with others. It is the belief of the writer that the only true test is furnished by determining what is a satisfactory surface of each type of surface under real conditions of use; in other words, by observing streets and roads, not fractions, surfaced with those classes of material which among the many have given the best satisfaction; determining just which are the conditions under which each of these proves most advantageous; comparing types, traffic conditions, those of climate and other features as developed in different communities, and selecting from among all, the governing conditions which must be met and the classes of wearing surface most suitable to meet them. In this way our variables are reduced to the fewest number.

We have certain conditions which must be met in each community and in each fraction of each community; the type of traffic that is to be encountered, the way the district in which the street in question serves is built and occupied, the features most desired by those who will use this road and those who occupy the ground adjacent to it. These being known, there remain only to consider the questions of available materials and financial possibilities. It is useless in a problem where the final results are desired only to the nearest unit to carry on intermediate operations to the tenth place of decimals, but this is what is frequently done by many so-called experts and by committees of volunteers studying the pavement situation in the hope of producing some startling improvement in our great communities. Most of the above enumerated variables are known for any particular place, and a careful study of their relative importance will reduce the ultimate choice to a very few possibilities. There has been sufficient road and street construction under existing traffic conditions to enable any intelligent engineer or city official by a careful study and inspection to determine what is most satisfactory under the conditions which he has to meet. The best pavement in the world for some particular set of requirements might be an absolute failure under others. No series of pronunciamentos based on results of a set of experimental test sections of street or road can justly be made classifying wearing surfaces and stating what is most satisfactory; but intelligent study directed to any existing problem will very easily lead to a limited set of correct conclusions.

Sand Cushion vs. Mortar Bed for Wood Block Pavements[*]

By T. S. Oxholm[†]

IN America it has been the custom for many years to lay wood block pavement on a concrete base with a cushion of sand or a bed of mortar between the base and the blocks. At present in European cities the concrete is laid perfectly smooth and the blocks are placed directly thereon, although fifteen years ago a mortar bed was used in London. In order that the reasons for the American practice may be discussed with understanding, the specifications used in the Borough of Richmond, City of New York, follow:

> On the surface of the concrete shall be placed a bed of (sand) dry mortar, composed of one part of cement to four parts of sand, one-half inch thick.
>
> On the surface of the mortar bed shall be set strips of wood three inches wide by one-quarter inch thick, and of the greatest length convenient for handling. These strips shall be carefully set parallel and about eight or ten feet apart, running from curb to curb, and be imbedded in mortar throughout their lengths, so that the top surface shall be the required depth below and parallel to the grade of the finished pavement. The space between two strips having been filled with mortar, a true and even top surface shall be struck by using an iron-shod straight-edge on the strips as a guide, and as soon as the bed has been struck, the strips which would interfere with laying the blocks shall be removed and their places carefully filled with mortar.
>
> On this mortar surface, spread and smoothed as above to the proper crown and grade, the blocks are to be laid with the grain up, with close joints, and uniform top surface, in courses at right angles to the line of the street, except in and between car tracks, in intersections and in other special cases, when they shall be laid diagonally, as shall be directed.
>
> When laid, the blocks shall be covered with clean, fine sand, entirely free from loam or earthy matter, perfectly dry and screened through a sieve having not less than twenty meshes per linear inch, the sand to be swept and brushed into the joints. The pavement shall then be rolled with a four or five-ton roller, and sand spread over the pavement and left on the surface until such time, when, if required by the Engineer, the pavement shall be swept clean for final inspection, and any defects then noted shall be remedied.

It would seem from the foregoing that a sand cushion was intended primarily to smooth out the roughness and inequalities in the concrete, so that the blocks might rest evenly thereon. Secondly, the yielding surface of the sand permits the roller to press the blocks into it until they present a smooth surface adjusting the slight inequalities in the depth of the blocks; and thirdly, the sand has a slight resiliency and protects the blocks somewhat from surface wear. The mortar bed performs the same office as the sand as an equalizer of the concrete surface and the surface of the finished pavement, but there the similarity ceases, for, as the mortar gradually sets it forms a hard unyielding bed for the blocks to rest upon, sacrificing resiliency for immobility.

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[*] Presented before Section D of the American Association for the Advancement of Science, at the Philadelphia meeting, December 30 31, 1914.

[†] Engineer in Charge, Bureau of Engineering, Borough of Richmond, New York City.

In the writer's opinion there are two objections to the use of a sand cushion. First, when cuts are made for any purpose through the pavement, it frequently happens that weeks and months elapse before repairs are made; during this time, storm water works its way between the blocks and base and disturbs considerable quantities of pavement that will have to be relaid. This is especially noticeable on streets with a considerable grade, and could not occur with a well-set mortar bed. Second, it would mean the unstable condition of each block with respect to its neighbors, and a consequent lack of support on sides and ends which is of the utmost importance.

The one objection to a mortar bed has always been that the mortar has been mixed damp and time must be allowed for it to set hard (three or four days), before traffic could be admitted, whereas wood block pavement on sand cushion can be thrown open for traffic as soon as completed. The writer has overcome this objection by mixing the mortar dry, and allowing it to set as moisture reaches it through the joints which are always of sand. The roller and immediate traffic, work the blocks down to their final beds before the mortar sets. Work of this kind has been examined at plumbing cuts and it has been found that the mortar was set up hard, though traffic had been allowed on the new pavement as soon as completed, and the surface was still uniform.

The fact of the lack of use of sand or mortar cushion in the practice of European countries would appear to indicate their opinion that a firm and unyielding bed for the blocks was the main consideration, relying entirely on the fibre of the wood for resiliency.

For many years asphalt blocks have been laid on a mortar bed and this method has evidently been adapted for use in laying wood block pavement. Some six years ago the writer used a damp mortar bed for a wood block paving contract. One day the roller broke down at a time when a large yardage of block had been laid and was ready for rolling. Before the roller was repaired the mortar had set and the pavement on this section was never as perfect as on those adjoining. For this reason a sand cushion was substituted for a mortar bed in the specifications until last year when dry mortar was permanently adopted. In the writer's opinion mortar is superior to sand for a bed for wood block pavement.

Brick Paving Construction at Toronto

Contributed by F. A. Churchill, Conneaut, O.

ILLUSTRATED herewith are views of recent paving work carried out in the city of Toronto. The work was done with Wire-Cut-Lug Brick, for which an order for 142,000 of the Hillside block was placed with the United Brick Company's plant at Conneaut, Ohio. The brick was laid during the early days of November last.

Christie Street, Toronto, is paved with the hillside block for a width of 46 ft. and a length of 700 ft. The bricks are laid longitudinally, so that the longitudinal joints run lengthwise of the street. The method employed in laying the brick at the base of the hill, causing the longitudinal joints running up-grade to conform with the curvature of the street, enhances the appearance of the finished work considerably.

The structural details of the pavement include a natural sub-base, graded to the proper surface conformation, upon which a six-inch concrete base is laid. The concrete base is brought to a true cross section, conforming to and parallel with the curvature of the pavement. Upon this there is laid a sand bed 1½ in. deep. The sand for the bed is fine—a sort of quicksand, taken from an excavation on Bathurst Street. The sandbed lies between a thick earth deposit and a blue clay base. It is about twenty feet thick and is compacted so solidly that it can be carved in relief

Paving construction under way on Christie Street hill, Toronto. Paved with Wire-Cut-Lug Hillside brick. November, 1914.

figures on the face of the bank. Experiments proved this sand exceptionally well adapted to the making of a sandbed, as it was easy of manipulation with a template, showed no tendency to roll up or soften in spots, and lent itself readily to rolling into a smooth, even, solidly compacted bed.

The extreme fineness of the sand and its superior quality as a bedding material emphasize the need of making allowance for local variants in specifying the kind of sand to be used for beds. It is commonly held that sand which contains not to exceed twenty per cent. loam and that will pass a one-fourth inch screen is required for a bed. Extremely fine sand is rather discouraged.

The sand now being used in Toronto proves that if the maximum size of the grains and the maximum percentage of loam be not exceeded, the properties of the sand may safely be considered in determining the choice.

For working purposes, no better sand for a bed could be found than the almost flour-like sand now being used in Toronto, and which is being taken from the Bathurst Street cut.

There is some misconception regarding the function of a sand bed. It is generally supposed—and, indeed, some authorities positively assert—that the sandbed serves the essential purpose of cushioning the pavement so that it shall have a degree of resiliency. This opinion was held quite generally at one time, but it is now being discarded by the most experienced engineers. The only object of a sandbed is to overcome the inequalities in the surface of the concrete base, so that the brick shall rest upon an absolutely even base. If it were possible to finish the concrete foundation perfectly smooth and at all points at a true parallel with the required surface of the pavement, a sandbed would be unnecessary. The theory of a required resiliency is at variance with the monolithic principle of brick pavement construction. The argument is valid that a pavement which is virtually a solid structure from the sub-base to the surface is less liable to suffer fracture than a pavement that has even a slight springing quality. The sandbed is designed to give the brick a uniform bedding surface, and when the bed performs that function its usefulness is ended. I make this assertion with full knowledge that many individuals who have made a study of the subject hold opposite views.

In forming the bed, the engineers provided every mechanical accessory which experience had demonstrated necessary. A template of approved design was made for shaping the bed.

Guide timbers, 1½ in. x 4 in., were laid for the ends of the template to run upon. These timbers were laid at the curb and in the centre of the street to a true line parallel with the grade at the centre of the street and next to the curb. Upon them were placed half-inch strips so that the template should leave the bed one-half inch above the required grade.

After the template had been drawn over the bed, the strips were removed and a hand roller weighing about 200 pounds was used for compacting the bed. The hand roller was of the twin-cylinder type. After the rolling, the template was again drawn over the bed in order to make the surface uniformly smooth and even.

At every stage extreme care was exercised in getting the desired results, and when the brick were laid the surface of the pavement had the appearance of having been rolled.

Wire-Cut-Lug hillside brick are not laid with their length transversely to the street, but longitudinally.

Another view and another stage of the Christie Street paving work at Toronto.

Wire-Cut-Lug brick paving (Hillside brick) at the Davenport Road subway, Toronto.

The reason for this method of placing the brick is found in the grooves, two of which, beside the end grooves, extend crosswise of the surface of the brick and distant about three inches apart. By breaking joints at the beginning of the pavement, at the end of the street, the joint is theoretically, and for the most part practically, broken at each brick, so that instead of grooves extending in a continuous line the full width of the street, as in the case of hillside brick with edge grooves, the grooves are broken up. This gives the shoe-calks of horses a foothold almost anywhere, yet it allows vehicles with broad tires to pass over the pavement without appreciable jar, as the tires, being wider than a single course of brick, find a continuous tread over the pavement.

After the bricks were laid they were rolled with a two-ton self-propelling tandem roller.

The final, and, in some respects, the most important part of the work was the grouting of the pavement. For this purpose a rather coarse pit sand, well screened, was used. This was mixed with a good grade of Portland cement in proportions of 1 to 1. The first mixing was done dry. When the dry sand and cement had been thoroughly mixed, the grout was made in a grout box, by hand. As water was added to the mixture the contents of the box were thoroughly stirred with hoes having broad blades with circular holes in the centres. The stirring was kept up continuously while the grout was being scooped from the box and poured into the joints between the brick, in order to prevent the ingredients of the mixture from separating.

The grout-box deserves special mention, because of its practical merits. It was a rectangular box, made of planking and mounted upon wheels about 12 in. in diameter. The wheels were so placed that the box could easily be tipped so that its contents would flow to the front end. The rear of the box rested upon legs about 6 in. long, and the box was wheeled from place to place and tipped by means of rear handles such as are affixed to wheelbarrows. One man could easily wheel this box and tip it, on account of the size of the wheels and their adjustment near the axle of the box.

The grout was not dumped but scooped out—the right way of handling it if good results are hoped for. Obviously, on a steep grade it is necessary to begin brick laying at the bottom of the grade, and the same rule applies to grouting, so that the grout, in obeying the law of gravitation, will not run out of the courses.

Hillside brick are not laid in courses straight across the street, but in courses which run obliquely across the street. This method is necessitated by the laying of the brick longitudinally. One of the accompanying views illustrates this.

The first course of grout was worked into the joints with stiff brushes, but the final course was worked with a squeegee, an implement consisting of a straight-edge board, with a piece of split rubber hose or pieces of rubber belting attached to the edge. The squeegee works the grout into the joints and makes them flush with the surface of the pavement—a finish which is impossible to accomplish with brushes, or brooms, as the latter brush the grout out of the joints at the surface. After the final course of filler began to set, the grooves in the brick were brushed out with wire brushes.

The upper portion of Bathurst street, to Nina street, was paved last November with wire-cut-lug paving brick. The Bathurst Street pavement is 46 feet wide between curbs.

The Davenport Road subway, a view of which is shown above, is another noteworthy piece of work. carried out last season.

As a result of large orders received from British and French manufacturers, the Steel Company of Canada will re-open its works at Hamilton, with a full staff. Many other factories in the Ambitious City are busy on war orders, and this, taken in conjunction with the announcement made by His Worship Mayor Allen to the effect that several large United States industries will locate in the city early in 1915, makes the industrial outlook bright for Hamilton.

The American Concrete Institute has appointed a special committee to investigate the behaviour of the concrete buildings in the Edison plant. The committee consists of Mr. Cass Gilbert, the well-known architect, chairman; Mr. E. J. Moore, of the Turner Construction Company, New York, secretary; Mr. Walter Cook, architect; Mr. J. Max Taylor, architect; Mr. R. P. Miller, of the New York Building Department; Mr. W. H. Ham, engineer, of Boston; Prof. Charles L. Norton, of the Massachusetts Institute of Technology; Mr. Richard L. Humphrey, consulting engineer, of Philadelphia, Penn.

Design of Two Residential Sewage Treatment Plants, Including Settling Tanks of the Imhoff Type[*]

By Samuel A. Greeley[†]

HIGHER standards of sanitation and a more general knowledge of the nuisances and dangers resulting from improper sewage disposal are requiring architects to seek the co-operation of sanitary engineers in the design of sewage treatment plants for residences and institutions. Experience is showing them that special knowledge is required properly to design such plants and that local conditions must be considered. Owners of estates where there are no public sewers are looking for the best and most practical method of treating their own sewage, so that they may require of their neighbors equally satisfactory methods. The discharge of raw sewage into ravines or small streams will make nuisances and sources of disease which may be distributed by flies or contracted by children. Conditions like this have recently called for the design of two residential sewage disposal plants in a small town near Chicago. These plants are here illustrated and described.

The town is cut by seven main ravines extending easterly from the centre of the town to Lake Michigan. The extension of sewers across these ravines is difficult. Consequently the high land along one large ravine at the southern end of the town is not sewered and the residences adjacent need individual sewage treatment plants. The flow of water in the bottom of the ravine is negligible during the summer months, so that a thoroughly stable effluent from the disposal plant is necessary for discharge into the ravine.

At both residences the plumbing and outlet sewers were built before the designs for sewage disposal were undertaken, so that the location and elevation of the end of the outlet sewer were fixed. This and certain other local conditions placed limitations upon the designing engineer. The hearty co-operation of the architects in both instances helped to offset these limitations.

Residence A was designed by Mr. Howard Shaw. Sewage disposal is required for the residence, a group of service buildings and a small garage. The number of people was estimated to range from 22 to 28. The outlet sewer for all of the establishment terminated in a small ravine tributary to the main ravine. The outlet was set too low for sub-surface treatment on the flat ground above the ravine. The fall to the bottom of the main ravine, however, was about 50 feet.

There was not sufficient space in the small ravine or the main ravine for sand filters. Moreover, the desirability of covering these would have added to the cost and would have made cleaning and attention diffi-

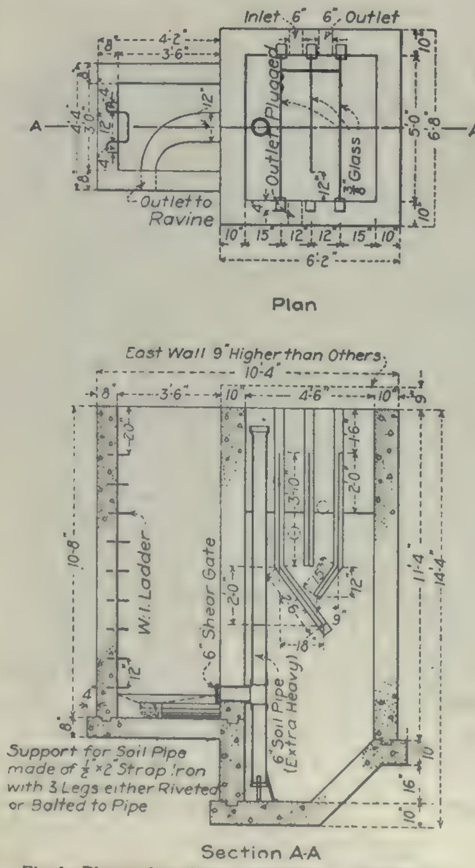

Fig. 1—Plan and section of Imhoff tank at Residence A.

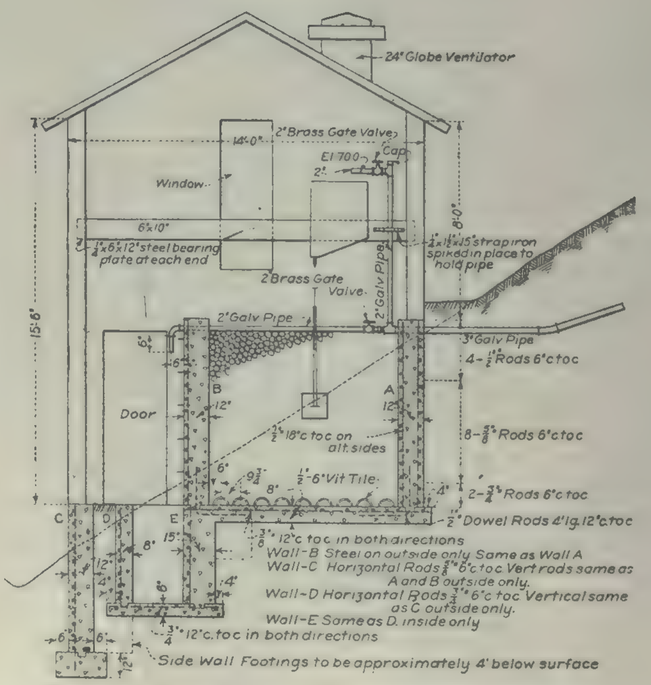
24" Globe Ventilator
14'-0"
2" Brass Gate Valve
Cap
El 700
2"
Window
6"×10"
1/4"×6"×12" steel bearing plate at each end
8'-0"
1/4"×1 1/2"×15" strap iron spiked in place to hold pipe
2" Brass Gate Valve
2" Galv Pipe
2" Galv Pipe
15'-6"
3" Galv Pipe
4-1/2" Rods 6" c to c
6"
6"
B
12"
A
12"
Door
1/2" 18" c to c on alt. sides
8-5/8" Rods 6" c to c
6"
9 3/4"
8"
1/2"-6" Vit Tile
4"
2-3/4" Rods 6" c to c
C
D
E
1/2" Dowel Rods 4' lg. 12" c to c
15"
8"
3/8" 12" c to c in both directions
Wall-B Steel on outside only Same as Wall A
Wall-C Horizontal Rods 5/8" 6" c to c. Vert rods same as A and B outside only.
12"
4"
6"
4"
Wall-D Horizontal Rods 3/4" 6" c to c. Vertical same as C outside only.
Wall-E Same as D inside only
3/4" 12" c to c in both directions
6"
6"
12"
Side Wall Footings to be approximately 4' below surface

Fig. 2—Section through sprinkling filter and housing, Residence A.

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[*] From Engineering and Contracting, Chicago.

[†] Hydraulic and Sanitary Engineer, Winnetka, Ill.

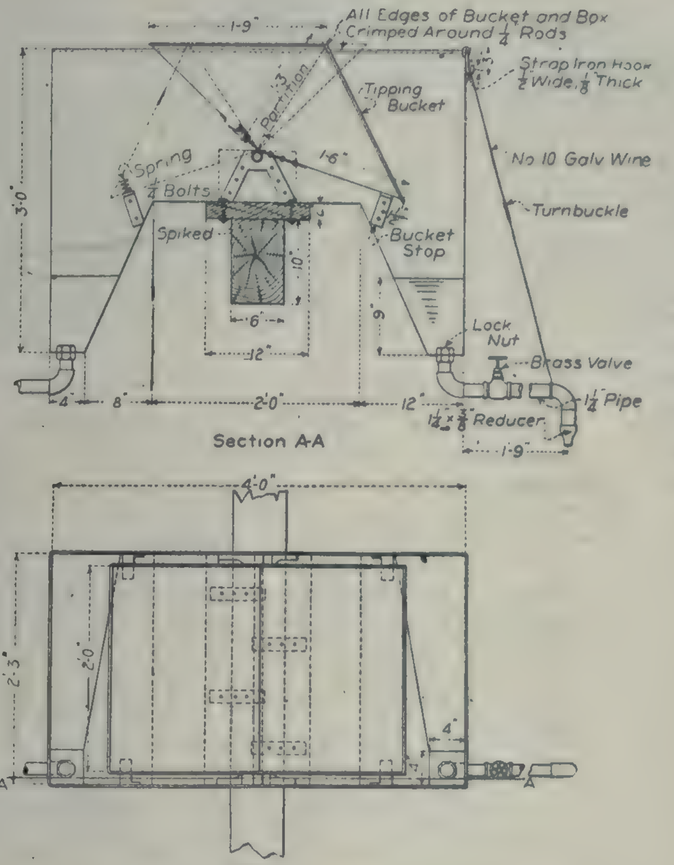

Fig. 3—Plan and section of dosing tank, Residence A.

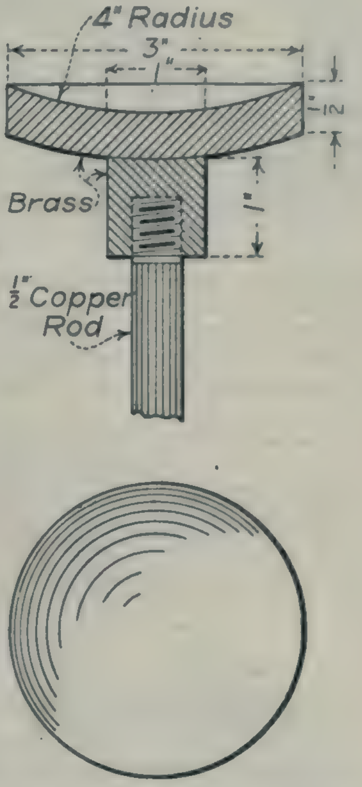

Fig. 4—Detail of splash plate, Plant at Residence A.

cult. There was plenty of fall for sprinkling filters, and these were considered preferable to contact beds. The layout finally adopted included a settling tank of the Emscher or Imhoff type, a covered sprinkling filter and a small secondary settling basin. The details of the design are shown in Figs. 1, 2, 3 and 4 .

The average daily flow of sewage was taken at 50 gals. per capita and the rate during the daytime was taken at twice the average rate, the plant being designed on a basis of 25 people. The Emscher tank was designed to give a settling period of three hours on the average daily rate of flow. The sludge digestion space is estimated to provide 20 months' storage. The floating sludge space was made large, amounting to 125 per cent. by area of the surface of the tank. This was done because of the character of the sewage. A sludge draw-off manhole was built, but no sludge bed was deemed necessary.

Novel features of the Emscher tank are the wire-glass baffles separating the settling compartment from the sludge chamber. These were selected for structural reasons as being the easiest to install and offering a desirable and lasting material.

The settled sewage flows to a covered sprinkling filter designed to operate at a loading rate of 10,000 people per acre per day. There is a manhole in the line from the settling tank to the filter. The sewage is applied to the filter by a tipping bucket which discharges 1.5 cu. ft. alternately onto one of two brass splash plates. The tipping bucket, illustrated in Fig. 3, is a very simple dosing apparatus, not subject to the danger of breaking if not in use during freezing weather. Each bucket discharges into a galvanized sheet iron hopper designed to give a varying head and varying quantity of sewage, corresponding to the decreasing annular area of filter reached by the spray.

The splash plates, illustrated in Figs. 4 and 5, are of brass, screwed onto copper rods working in galvanized iron pipes anchored into the filter material by a concrete block. They were selected to avoid trouble with nozzles clogging.

The filtering material is 6.5 feet deep, composed of 1¼-in. to 2¼-in. Wisconsin limestone carefully graded and washed. The underdrains are half-round tile, sloping to a main drain in the concrete extending along the centre of the floor. Riser pipes from the underdrains for ventilation and flushing are set in each corner outside the circular spray line.

A shallow final settling basin is provided having a sloping bottom and large enough to give a settling period of 1.5 hours on the average daily rate of flow.

It was considered advisable to cover the filter and final settling basin with a small house, 17 ft. by 14 ft. in plan. This was done to prevent any possibility of odors and to give the plant an attractive appearance. The house was built of hollow tile, rough plastered with cement mortar and covered with a blue slate tile roof. The design conforms to the other service buildings on the estate. Four windows, a door and ventilator are provided. The house sets low on the side ravine and is not visible from the residence.

All parts of the plant are accessible, and bypasses are provided for the filter and final settling basin, but not for the Emscher tank.

Bids were received for the construction of the plant in accordance with Table I, which gives the engineer's final estimate. The total amount of the bid was very close to the engineer's estimate and is a fair figure for the cost of the work.

The work at Residence B was done in conjunction with extensive additions to an old house. The architects were Messrs. Richard E. Schmidt, Martin and Garden. The disposal of sewage was required for the residence only, the estimated number of people ranging from 15 to 25. Meter records of the water supply were available, showing an approximate average daily consumption of 50 gals. per capita. The new sewage works were designed on this basis.

The old house was provided with a large sand filter and there was available, therefore, a large quantity of sand. The main sewer from the new house was set at a sufficient elevation so that an area for sub-surface disposal could be made available by grading down the present surface about 3 ft. The soil was heavy clay, so that the excavated space was refilled with the available sand to make a soil suitable for sewage treatment.

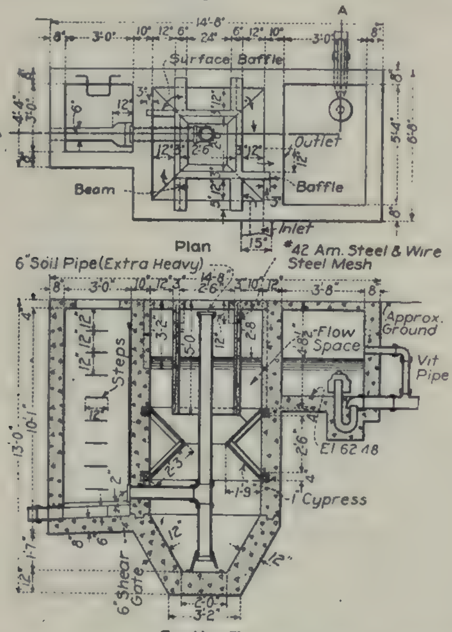

Fig. 5—Plan and section of Imhoff Settling Tank, Residence B.

There was sufficient sand available to make a disposal field covering approximately 6,000 sq. ft. Owing to these local conditions it was found expedient to select treatment by preliminary sedimentation, followed by sub-surface irrigation in a sandy soi.l

The settling tank is of the Emscher type, illustrated in Fig. 5. The sewage flows around the tank in the flow space at the outside, with a floating sludge space at the centre. This gives a long travel and ample opportunity for large particles in the sewage to become water-logged and sink. The flowing through time, based on the average daily flow, is six hours. This was considered safe on account of the final treatment below the surface of the ground. The sludge digestion chamber has sufficient capacity for 20 months' storage. A sludge outlet manhole is provided. The lower deflecting baffle in this tank is built of creosoted cypress. It was built up outside the tank and lowered into place and nailed to the horizontal cypress strips previously anchored into the concrete side walls of the tank. The upper baffles of the tank are built of concrete. These were cast outside the tank in four slabs, each reinforced with 2-in. wire mesh. The mesh was left extending from the upper end of each slab about 6 inches. These slabs were lowered into the tank with an A-frame, and the wire reinforcement fastened to steel rods set in concrete beams spanning the tank. The corners were afterwards reinforced and plastered with cement mortar.

Table I.—Engineer's Final Estimate for Sewage Treatment Plant at Residence A.

Item.	Cost.
Earth excavation, 284 cu. yds. at $1.00 ..	$284.00
6-in. vitrified pipe, 346 ft. at 25 cts.	86.50
Steel reinforcement, 2,879 lbs. at 4 cts. ..	115.16
Settling tank and manhole, lump sum	400.00
Dosing apparatus, lump sum	95.00
Sprinkling filter, lump sum	520.00
Filter house, lump sum	620.00
Total of estimate	$2,120.66

The settled sewage flows into a siphon chamber, in which is a 4-in. Miller siphon. This siphon discharges through a line of 6-in. tile pipe to a diverting manhole, where the discharge or flush may be turned to either half of the sand filter, as desired.

The sewage is distributed over the filter area through a system of 4-in. tile laid with open joints and terminating in short riser pipes. These distribution tile are set into a sand cover of from 9 to 12 inches. Below these, 3 to 4 ft. from the surface and set in trenches, are the collecting tile, draining to a main drain at the centre. These collecting tile are completely surrounded with coarse gravel. The effluent discharges through a sand bank into the main ravine.

The cost of the settling tank complete, including the Imhoff royalty and the siphon chamber, was $385. The filter work was done by day labor under the direction of the writer's resident engineer.

The design of Emscher tanks for small works is new, but is in line with present developments. The tanks are no smaller than a number that have been successfully operated at testing stations. Certain modifications have been made to meet this special service. Experimental work along this line is now being performed by the U. S. Public Health Service, two test plants having been built, one for the sewage of 15 people and another for the sewage of 100 people. A more noteworthy feature is the indication that architects and owners are realizing the need for a rational design of small sewage treatment plants with due regard for differences in local conditions and the degree of purification required.

The plants were designed by the writer and built under his supervision. Mr. Robert A. Alton, recently of the New York State Board of Health, was resident engineer. The L. K. Sherman Company, of Chicago, was contractor for both installations. Both plants went into operation in June, 1914, and have been working satisfactorily since that time.—Engineering & Contracting.

A water-supply main at Keyser, W. Va., was packed full for 50 ft. recently by roots from a single poplar tree. The pipe was a gravity supply main of vitrified tile with cemented joints, and had been laid for over twenty years. The roots nearly stopped the flow of water in the pipe.

A Road Congress at San Francisco in 1915 will probably be conducted jointly by the American Highway Association and the American Road Builders' Association. Each association is to appoint a committee of two, and the four thus appointed are to choose a fifth member, thus forming an executive committee of five to conduct the congress.

Steel Structural Engineering—Some Phases of Its Past, Present and Future

PAST, present and future phases of steel structural engineering are reviewed in a recent issue of the Engineering Record by Edward Marburg, Professor of Civil Engineering in the University of Pennsylvania. Professor Marburg considers first some of the influences which have contributed to the advancement of steel structural engineering and then refers to conspicuous examples of present-day practice, directing attention finally to some of the problems of the future.

Following the introduction of the open-hearth steel process, wrought iron for structural purposes was superseded by steel about twenty years ago, writes Professor Marburg. The advancement since that time has probably exceeded the most farsighted anticipations.

Progress in Design and Fabrication

The problems of design and fabrication are so closely interwoven that it seems best to treat them jointly in this brief review. Considering, first, the ordinary run of bridge work as distinguished from structures of exceptional magnitude, remarkable progress has been made within recent years, especially in connection with railroad bridges. The reason for this lies largely in the fact that the railroads have come to recognize the evils of that vicious system by which formerly tenders for bridges were solicited on the basis of little more than a profile of the site and general specifications, and contracts were closed at lump-sum figures on mere stress-sheet designs. Under that system, with its strenuous competitive features, the bridge companies found it difficult to secure work at a living profit, save by skimping details to the limit of conscience and ingenuity. The change to the pound-price plan, under increasingly competent supervision, has perhaps contributed more largely, though indirectly, towards the elevation of standards in American bridge practice than any other single influence. It is fortunate that this radical change of attitude between purchaser and manufacturer should have come about coincidently with the introduction of heavy engine and train loadings which are not likely to be much exceeded for many years, so that modern steel railroad bridges may at length be regarded as measurably permanent structures.

An important collateral factor towards the raising of standards in bridge work is to be found in the increasing use of the well-balanced specification framed and maintained under the wise co-operative plan of the American Railway Engineering Association.

The realization that a bridge should be proportioned and braced to resist the action of the external forces as nearly as possible as an integral whole, has profoundly influenced American bridge practice within recent times. It has resulted in the increasing use of rivetted trusses, rivetted connections for members subject to stress reversal, stiff rivetted bracing, rivetted floorbeam connections, end floorbeams, solid ballasted floors, etc., and in the abandonment for railroad bridges of the rattletrap details in vogue twenty years ago. All-rivetted trusses were used for the 408-ft. spans in the recent renewal of the Lachine Bridge; and have been adopted in the 581.5-ft. draw-span of the proposed Burrard Inlet Bridge, Vancouver, B.C., and in the design of the two 775-ft. channel spans of the Sciotoville Bridge across the Ohio, to which further reference will be made hereafter.

Remarkable progress has also been made within recent years in the fabrication of plates and rolled shapes in larger sizes, in drilling or reaming large joints or complete trusses after assembling at the shop, in the use of metal templates and in the tapering of long rivets. A few years ago the large riveted connections in view of the Sciotoville Bridge, involving gussets about 12 x 15 ft. and 1⅝ in. thick, exceeding those for the Quebec Bridge and the Hell Gate Arch, could not have been fabricated.

The development of the theory of secondary stresses has already had a wholesome effect upon the general and detailed design of trusses. Too much emphasis can hardly be laid on the importance of utilizing this added knowledge by avoiding conditions calculated to increase secondary stresses rather than by seeking to take them into quantitative account in justification of improper design.

With respect to design in its bearing on the development of new types of structures, deserved prominence should be given to the rapid evolution of bascule and vertical lift bridges, and the more recent though no less radical changes in the design of trainsheds. The applicability of double-leaf bascule bridges has recently been much extended through the perfection of means of transmitting full direct stresses in addition to the shear across the central joint of the closed structure acting as a simple span.

Improvements in erection methods have kept well abreast of the advance of bridge construction in other directions. The evolution of the modern derrick car with a maximum boom-length of 110 ft.—capable of handling with a boom-length of 70 ft. a 115-ft. girder weighing 60 tons—and the development of locomotive crane, have within recent years completely revolutionized erection methods for the ordinary run of work. Their use has resulted in cheapening and accelerating erection.

The practice by which new bridges designed to replace existing ones are completely constructed to one side and then rolled into place is growing in favor and has led to some remarkable records. An especially sensational performance of this kind occurred recently on a Pennsylvania Railroad bridge over the Muskingum River when three 240-ft. double-track through bridges, weighing in the aggregate 3,500 tons, were moved laterally 45 ft. in 10 minutes and 17 seconds between trains. The same method was recently applied, without interruption to traffic, to the installation of eleven new 175-ft. double-track deck spans weighing 600 tons each, in the reconstruction of the Ohio Connecting Bridge, below Pittsburgh.

The method by which bridges are constructed on barges and floated into place, and shifted or removed by that means, has found numerous recent applications with ingenious modifications to suit special needs. The most important and spectacular feat in that line will take place when the 640-ft. double-track suspended span of the Quebec Bridge, weighing 6,400 tons, will be floated into position and then lifted bodily to a height of 150 ft. above the water level to its final place in that structure. In its application to this bridge this method not only ensures a great reduction in the erection stresses by the pure cantilever method, but also obviates all hazard from sudden temperature changes in making the final central connection that would otherwise have had to be incurred.

There have also been many interesting recent performances in the adaptation of the cantilever method to the erection of simple spans and other structures to which space forbids more than bare reference. The approaching erection of the Hell Gate Arch will prove an especially noteworthy example of this kind.

(Concluded in next issue)

Business Errors of Clayworkers—and Others

SOUND advice is contained in the following editorial published in the last issue of our London contemporary, The British Clayworker. While the observations apply particularly to the clayworking industry the principles for which they stand apply equally to all branches of the supply business:—

"Quite apart from the merely technical side of clayworking, though this is large enough to employ all the thoughts of any one interested in it, there are many ways in which even an experienced clayworker goes astray. For instance, the commonest of all mistakes is the attempt to do more business than the capital warrants. This is a temptation which may assail a man at any time during his business career, and even if yielding to it may appear to be justified on some occasions, it will always lead to disaster in the end. Not that it is recognized as such by most clayworkers; on the contrary, they complain that the cause of their failure has been insufficient capital, whereas the real truth is that without sufficient capital they should never have begun the enterprise or they should have withdrawn from it at the earliest opportunity. Over-ambition is one of the most fatal gifts a clayworker can possess, and the very feeling that if he only had a capital greater than he possesses he could make a fortune, is sufficient to wreck many a business.

"We remember one case of a brick manufacturer, who explained at a meeting of his creditors that he had enlarged his plant and spent large sums in new machinery simply because another firm had opened a brickyard in his immediate neighborhood. The new firm was seriously under-capitalized and only lasted about two years before it was closed down, but the expenditure which the older and larger firm had undertaken had so seriously affected the capital that debts began to accumulate and the business never recovered from the results of the fright of its owner. Extension, when unnecessary, is almost as serious an error as carrying an excessive load of credit, and its results may be equally disastrous. This is specially applicable to the introduction of a new line of goods which happens to be popular in another district.

"Some time ago, a visitor to one of the Building Trade Exhibitions at Olympia saw some bricks with an attractive appearance, due to the use of a special arrangement of the cutting wire used in their manufacture. Knowing the fondness of an architect in his own locality for bricks of an antique type, the clayworker at once set to work to produce bricks of the kind he had seen at the Exhibition. In a few weeks he had made several thousand bricks which soon became popular among a few local architects. Alas, their very popularity nearly ruined the maker, for he spent so much time in experimenting with these bricks and in subsequently trying to sell them that he lost two important contracts which would have kept his ordinary trade going well. Besides this, the time he had spent on perfecting his new bricks was not counted when he came to estimate the cost and he soon had to abandon their manufacture simply because he could only sell them at a price which yielded him less profit than his common bricks, as the latter could be made much more rapidly and did not need the same care in handling.

"Another serious error is the granting of too much credit by the clayworker. This is one of his greatest difficulties as a business man. If he makes the most careful enquiries as to his customer's ability to pay and finds him of "doubtful" status, what is to be done? To refuse credit may be to miss good business just at the very time when it is greatly needed; to grant credit may be to jeopardize the clayworker's business and possibly ruin him. Of course there is no general rule which can be applied to all cases, and each customer must be judged on his individual merits and especially on his character. A very common method is to take a lien on the property to be built, but to do this is to share the risks of the builder and, in effect, to enter into a business about which the clayworker may know but little. Moreover, it would often be more advantageous for the clayworker to undertake the whole responsibility of the building if he could only make the necessary financial arrangements. In doing this, however, he will probably make the mistake previously mentioned, of going beyond the powers of his own capital.

"The granting of credit is always a delicate and difficult task, and one which calls for exceptional qualities on the part of the man in whose charge this part of the business is placed. There is a natural tendency on the part of travellers to get credit granted too easily, nor do they care to act the part of enquiry agents, so that if the question of credit is left with them they will—as a rule—damage a business by lack of sufficient care. On the other hand, too cautious a method of granting credit will usually prove dangerous to the firm's business.

"One of the safest rules is to grant credit for a small amount at first and to extend it only if the payments are made as promised. This will generally save much unpleasant enquiry and tactless pressure. Unfortunately, some men are sufficiently unscrupulous to abuse this arrangement, and by paying their earlier orders very promptly they endeavor to gain an appearance of trustworthiness until they are in a position to get a large credit, the amount of which it is almost impossible to make them reduce. To avoid such a contingency, the only way is to get to know the customer intimately, to learn his tastes and hobbies, to study his temperament and the likelihood or otherwise of his being a man of his word. Trade enquiries are not enough, a far more intimate knowledge is necessary, and where this can be obtained, the natural instincts of the clayworker may usually be trusted to decide the limit of credit to be granted.

"Writing of credit reminds us that a well-known bank manager once told us that nine-tenths of the patrons of his bank who failed, did so because they could not collect their accounts. In many cases this is due to carelessness and irregularity on the part of the creditor during the earlier stages of the business, and it is usually found that care and promptitude in collection will keep the slow payers within reasonable limits. One of the most successful clayworkers of the present day makes it perfectly clear to each customer that he will expect payments to be made on certain days and he does all he reasonably can to impress the importance of this on his customers. If a customer arouses suspicion by an unwillingness to pay as suggested, or by an over-willingness which gives the impression that he is not going to pay at all, this clayworker generally manages to secure himself against loss.

"Another form of error is that of entering into a partnership. Nothing can so easily ruin a steady and reliable firm as an unsatisfactory partner. Indeed, his influence may extend so far that he not only brings down the firm, but he ruins the domestic peace of those originally owning the business. The laws regulating partnership in Great Britain are so clumsy that no simple partnership is really safe, no matter how carefully the agreement may be drawn up. Where a partner is necessary, the firm should always be made into a Limited Liability Company with precisely defined assets, as it is only in this way that the savings and private capital of the partners can be protected from an unscrupulous partner. The objections to the formation of a Limited Company are all trifling; the most important is its effect on the credit of the firm, but this can always be arranged so as not to damage the business in any way. It is obviously unfair that a business man should imperil the comfort of his wife and family by any errors he makes in business, so long as there is a means of protecting them from the most serious consequences of such mistakes. Moreover, it is a mistaken policy for a man—and particularly for a clayworker—to keep his accounts in an indifferent manner, so that he does not know how he stands and has all his depreciation funds in the business itself, or else makes no allowance for them. These errors are avoidable automatically by the conversion of a business into a Limited Company, as accounts have then to be kept in proper form. Moreover, when the end comes, as come it must, with his business in the form of a company with limited liability, the clayworker will know that his business can be divided equitably and without any disturbance in accordance with the directions contained in his will."

Legislation and the Engineer[*]

By G. R. G. Conway, Vancouver[†]

WE are confronted at the outset by the fact that the word "Engineer" means so many things to so many different people that even the prefix "Civil" does not define the exact scope of the work of the members of the Canadian Society of Civil Engineers.

"Civil Engineering," as understood by the three great engineering societies, i.e., the Institution of Civil Engineers of Great Britain, the American Society of Civil Engineers and the Canadian Society of Civil Engineers, embraces within its scope Civil, Railway, Municipal, Mechanical, Electrical and Mining engineering. The work of all these branches of engineering is so interwoven that it is difficult to draw a hard and fast line between any one branch. The work of the mining engineer may involve difficult construction, such as tunnelling and railroad building; the hydro-electric engineer is required to direct tunnelling operations, the building of large dams, railroads, power houses, and electrical plants; the railroad engineer's duties involve every branch of engineering, and the same is true of the irrigation engineer or the municipal engineer who may have to carry out great works of water supply and drainage. No man can be the master of all the separate branches of his profession, but the fundamental principles that underlie all engineering work are the same, and recognition of this fact is thoroughly appreciated by the great engineering societies in the requirements which they demand of engineers to qualify for studentship or corporate membership, and also by all of the engineering colleges in the training of the engineer to-day.

The principal object of the leading national engineering societies is to raise the standards of the profession from time to time, so that only competent engineers shall be entrusted with the design and construction of engineering works, both public and private. Our object is not to attain that result by adopting the principles of the trades unions, although their efforts in co-operation for the benefit of their special trades, might well have for us a useful lesson, but by increasing the value of our society so that it will be recognized that corporate membership has such a standing in the engineering world that our public authorities will appreciate the fact when entrusting the engineer to carry out public works.

In England the high standing of the Institution of Civil Engineers is such that the institution is consulted freely upon all great public questions; in fact, to-day, in this great period of struggle, the President and Council's services are eagerly sought after by the British Government for recommendations as to satisfactory volunteer officers for both arms of the service. No royal commission is ever appointed on any matter connected with public works, nor are government bills ever introduced on any subject where the engineer's advice is required, without the Institution being the recognized adviser of the Government. This confidence has been gained by the fact that all the leading engineers are faithful to it, and its long and honorable record has earned for it that commanding position. In the United States the American Society, too, has gained, though in a lesser way, a large and commanding sphere of influence. The influence of the Canadian Society of Civil Engineers, with its large membership spread over a continent—from the Atlantic to the Pacific—will, I think, if we all pull together, also have a great and powerful influence throughout the whole of Canada. The Society numbers among its ranks the ablest engineers in the country—men who have been prominent in building up the provinces, and who have been responsible for great engineering works.

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[*] From a paper read before the annual convention of the Victoria and Vancouver Branches of the Canadian Society of Civil Engineers, held at Victoria last month.

[†] Chairman, Vancouver Branch Canadian Society of Civil Engineers; Chief Engineer, B. C. Electric Railway.

We have resident in the province, however, members of the Institution of Civil Engineers, and also of the American Society, who are not yet members of our own Society, and I think we should do our best to persuade these engineers to gain admission to our ranks, as no matter to what other societies we may belong it is our first duty to foster and develop our own national society.

I am not a believer that the present time is ripe for any proposals of a drastic nature in connection with the question of licensing or registering engineers. The subject is so complex that in my view much discussion and educational work is necessary before we can ask either the provincial government or the Dominion government to legislate specially in our favor. We realize that the difficulties are great, and because of their existence the Manitoba Act, which was passed in 1896, and the Quebec Act, which was passed in 1899, have become a dead letter. This, though, I think is due partly to the apathetic feeling of the engineers themselves, but in all young countries depending for their supply of engineers upon new-comers, during periods of active development, there is a danger of specific legislation defeating the object we have in view.

The B. C. Viewpoint

We do not want to bolster up an engineer merely because he is a member of the Society; we want the Society to be recognized as, and actually to be, a group of well-trained and competent engineers, who collectively command enormous influence with public authorities, and whose advice is sought because they bear the honored rank of corporate membership.

The British Columbia members of the Canadian Society have been active in endeavoring to obtain in various government Acts a definition of the functions of the engineer as applied to work carried out under provincial legislation. In these activities we have already obtained, during the last session, the sympathetic ear of the members of the Executive Council, and a definition has been included in the Water Act of 1914. That is a step in the right direction, though quite inadequate to protect the public against incompetent advisers.

It has been suggested by a legislative committee of our two branches that a special Act might be introduced with a view to its receiving legislative sanction during the present session, but the difficulties are so great that in my opinion it would be unwise to attempt anything of the kind at the present time.

In many public acts the looseness regarding what constitutes an engineer must be revised. I refer more particularly to the following Acts:—Ditches and Water-Courses; Drainage; Dyking; Irrigation; Municipal; Public Works; Railway; Sewage and Water.

"Civil Engineer . . . or Such Person"

We all know the famous definition in the Water-Courses and Ditches Act which naively describes an "Engineer" as—"Civil Engineer, Provincial Land Surveyor, or such person as any municipality may deem competent and appoint to carry out the provisions of this Act."

Most of us have had experience of the ability of an elected alderman or a council to decide who is competent. I do not wish to say anything disrespectful regarding those gentlemen to whom we give the power to run our local affairs; our object is rather to assist them so that municipal expenditure, for example, shall yield the greatest benefit, and the people's representatives have professional advisers who will see that waste is prevented and that every dollar spent shall be spent with maximum efficiency.

Our chief object at the present time is to have the functions of the engineer defined in specific acts, so that first of all the public shall be protected against incompetency. This, in my opinion, must be the first step. The engineers employed by the government, the municipalities, and under the various public bodies, shall be competent engineers, and those engineers who have to design schemes of railroads, water powers, bridges, irrigation projects, water supply and drainage, that must under the various acts be submitted to the provincial or Dominion governments for approval, shall be so designated that it will be shown that they are entirely competent and trustworthy officers to their companies or local authorities. If that were so, we should be approaching the English system, which practically recognizes that plans submitted to Parliament, in connection with parliamentary bills, or in connection with the local government board, if signed by a corporate member of the Institution of Civil Engineers, are guaranteed as to professional competency.

Careful Definition Required

The definition of engineer that we desire must be carefully worded. It must also be one that will be fair and just to all practising members of the profession. It must be a definition that will define the engineer referred to in any specific act as being a corporate member of the Canadian Society of Engineers, or of the Institution of Civil Engineers of Great Britain, or if the work is of a mechanical or mining nature, it must be such as recognizes the premier societies of those branches of the profession. In view of our proximity to the United States, it would also recognize the leading engineering societies of that country, although I do not think the broad and catholic spirit as shown in that case would ever be reciprocated by our cousins over the line, where all public and government works can only be designed and carried out by naturalized American citizens. For my own part I think we have much to gain by association with our professional brethren across the border, but in these times it is necessary for our own countrymen to stand together in strong nationalism when we are in the throes of a great world conflict, and say emphatically that our first duty is to our own people, and that our own people can, if our authorities will patriotically support them, find within the ranks of the Canadian engineers all the expert professional advice that Canada needs for her present and future development. That our own society is daily becoming more and more recognized, is shown by the fact that within the last eighteen months many practising engineers of reputation in the United States have sought and obtained admission to our ranks. This cordial feeling, too, is also shown by the fact that many Canadian engineers are members of the American Society, some of whom have attained high places in its councils. I recognize quite fully that in some great public works it is necessary to get the best advice possible without regard to geographical boundaries, and sometimes it is believed that experts should be obtained from over the border line. In this connection I do not think that we should insist that our government be prohibited from obtaining the best advice possible, but I do think that any appointments of that kind should be in an advisory capacity only to a recognized official Canadian engineer. I have known cases in Canada—and I am not referring here to any action on the part of our provincial government—where an engineer, called in under special circumstances from a neighboring country, in an advisory capacity, assumed almost autocratic power, and that power meant that many hundreds of thousands of dollars of good British capital were needlessly wasted. Had he, eminent man though he was, acted in an advisory capacity in collaboration with a Canadian colleague, or had he had any sympathy with the building up of Canadian enterprises, much of this money would have been saved and could have been used to build up a genuine enterprise instead of hampering its development. I have also heard of a Canadian enterprise being completely abandoned because the promoters felt sure that a foreign engineer would be called upon to approve the design, and in view of his reputation, they were justly alarmed in entering upon an important piece of work, not knowing whither they would be led.

In British Columbia I think we are fortunate in having Government officials who are most anxious to develop the province, and at the same time safeguard the interests of the public; and it is also a matter of congratulation that practically all these officials employed in various engineering capacities are members of the Canadian Society. It is because of this fact that we hope to obtain a sympathetic hearing from the Government, as their interests and ours are identical. We are also glad to know that many of the heads of various Dominion Government departments take a deep interest in the welfare of the Society, and are proud to be members and encourage its work.

Licensing or Registration

The question of licensing and registering engineers, as doctors and lawyers are registered, is too early yet, and we must educate our young engineers and raise the standard of the Society so that membership in its ranks will make any other registration unnecessary. During the last few years this subject has been discussed very prominently in the United States, and the differences of opinion there are very great. I think we are all agreed that official recognition of the profession of the engineer is desirable, and that the regulation of the profession, both in the interest of the public and of the profession itself, is a worthy object to attain. We can advance no reason why a lawyer or a medical man, a land surveyor, sanitary inspector, or a plumber should be licensed or registered, and an engineer not be. There was a case I noticed recently in an engineering paper of a county surveyor who could not understand a transit, and yet was elected by an overwhelming majority.

It has been argued that laws governing admission into the ranks of the engineer will not make engineers anything more than fussy pedants, and that the engineer's duty is to mix more in public affairs and see that his talents are recognized by a public that needs them. This may be true, but we in British Columbia are doing our best to educate public opinion on all important public questions where an engineer's advice is of value.

The Pennsylvania Movement

Perhaps one of the most interesting movements towards the licensing of engineers is that which has been in progress for some time past in Pennsylvania. In this State the Governor has appointed a commission to consider the question of whether or not legislation regulating the practice of engineering is advisable in the public interest. This movement has also been strongly supported by an organization of engineering employees in New York, known as the "Technical League." This body had bills drafted and introduced into the New York legislature, which was the cause of a general protest from engineers. The American Society of Civil Engineers by a unanimous vote in 1911 decided against legislative restrictions, but the subject has again come prominently to the front as the result of the Engineers' Commission appointed by the Governor of Pennsylvania.

The draft bill now under discussion applies to persons who practice "professional engineering." That term includes every branch of engineering except military engineering, and provides that "no person shall practice professional engineering after June 30, 1915, unless he is duly registered."

The bill provides a State Board of nine examining engineers to be appointed by the Governor, each member to serve six years. The qualifications for an examiner to serve on the Board are: (1) he must be a professional engineer of ten years' standing; (2) he must be of recognized standing and repute in his profession; (3) he must have the qualifications of the highest grade of membership in the American Society of Civil Engineers, or American Institute of Electrical Engineers, or American Institute of Mining Engineers; (4) he must be at least 35 years of age; (5) he must have been a resident of Pennsylvania five years prior to his appointment.

No person shall be examined for registration until he has paid a fee of $5.00 and taken an affidavit that he is over twenty-five years of age. He must be of good reputation and have had at least six years' experience, of which time he must have had charge as principal or assistant for one year. In lieu of this an applicant may show that he is a graduate of an engineering school of recognized standing, and have been engaged upon engineering work for four years, including one year as principal or assistant in charge.

If the results of such examination are satisfactory to the Board, a certificate of registration will be issued to the applicant permitting him to practice as a "professional engineer."

Only the following persons shall be entitled to registration:—(1) those who have passed the examination; (2) those persons registered from other States which require registration; (3) any person who shall before July 1, 1916, submit proof that he has been practising professional engineering for ten years, and has been in charge as principal or assistant for two years.

The Act makes it unlawful for any engineer to practice professional engineering unless registered, the penalty being a fine not exceeding $1,000, or not more than one year's imprisonment.

The Act does not apply (1) to any professional engineer while working for the United States Government; (2) to a professional engineer employed as an assistant to a registered professional engineer; (3) to a professional engineer coming from another state and temporarily practising his profession.

This draft bill has aroused considerable opposition, particularly from a committee of the Philadelphia members of the American Society of Civil Engineers. Their view is that an Act of this character, framed primarily in the interests of the public for the promotion of safety and the protection of life, health and prosperity, cannot attain its object, and that other measures are most effective for its accomplishment.

They claim that the examinations could not guarantee that engineering work would not be carried out by incompetent persons, and that the public would be adequately protected by state engineering departments and commissions whose duty it would be to enquire into all public works; e.g., in the same way as our own Provincial and Dominion departments are doing at present.

CONCLUSION

There are therefore three phases of the subject to be considered: (1) the protection of the public; (2) the recognition of the Society by the Provincial and Dominion Governments, and by the public authorities; (3) the licensing and regulation of engineers by a special Act.

We can attain (1) and (2) by united action, and (3) is unnecessary at the present time.

Our object should now be to define the title "Engineer" in specific acts, so as to avoid the unnecessary vagueness that obtains at present. This may be accomplished by the Provincial Government consenting to amend certain acts, or provide a general definition in the "Interpretation Act" of the revised statutes of British Columbia. Beyond attempting to do this, I do not think we should go at the present time; but our legislative committee should watch carefully the progress and discussion of the Pennsylvania bill, because I believe that whether that bill becomes law or not, all phases of the subject must be considered.

A further suggestion I wish to make is that our committee compile carefully a list of the references to the subject in the technical press. These have been quite voluminous during the last three years.

In conclusion, I think we, as members of the Society, should, when signing all plans that have to be submitted to the Dominion and Provincial Governments, use our proper designation as corporate members of the Society; and if we use our influence to add to the authority and dignity of the Society, we need have no fear that the engineer will not get the recognition that is his due.

Prosperity on the Turn in the West

Mr. Chas. F. Roland, Commissioner of the Winnipeg Industrial Bureau, reports improved conditions in the Western Metropolis. He tells us that every day brings additional evidence of returning prosperity, and that all indications point to progress and confidence. He continues:—"Building operations have been affected more by the conditions brought about by the war than any other line. A considerable number of contracts for apartment blocks and public buildings have been held up for want of money. With all this to contend with, Winnipeg has invested in 1914 the sum of $14,000,000 in new buildings.

"Following a period of five active years, in which over $80,000,000 have been expended in building in Winnipeg, and the extraordinary development of workmen's homes in the immediate vicinity, there is a balancing of the supply and demand, with the satisfactory result of a general lowering of rentals—amounting approximately from 25 to 30 per cent.

"The labor situation is better than was anticipated two months ago. Business men have grappled with the unemployment situation in a practicable way and have accomplished definite results. The resumption of provincial works to some extent, and the fact that the Greater Winnipeg Water District have employed some 1,500 men and the City Council have opened up other means of employment, have had the desired effect. What helped the labor situation was the fact that Winnipeg supplied 4,700 men for the first Canadian contingent and enlisted over 2,700 more with the second. This has placed Winnipeg's unemployment problem in such shape that the city is fully prepared to meet the situation during the winter.

"Real estate values in central districts and among residential sections have not declined to any extent during the year. Wildcat speculation has been practically wiped off the 1914 calendar. There are no bargains to be had in downtown investments in Winnipeg, although the market has been quiet and inactive. Local investors in real estate have the satisfaction of knowing that if their money had been invested in railroad stocks or many other securities the depreciation in value would have proved far greater. Winnipeg's position to-day as a whole is sound. The outlook for a greater industrial development is brighter than ever. The effect of the war has brought home the fact that every citizen owes to Canada and to Winnipeg the duty of patronizing home industry, capital and labor. During 1914 fourteen new manufacturing industries have located and a number of older establishments have added space and equipment.

"The marked agricultural development throughout the three prairie provinces in acreage under fall plowing this year means much for the West in 1915. Fully 33 per cent. more plowing has been done this fall than in previous years. Mixed farming is on the rapid increase in all districts that are suitable. With a dollar wheat market ahead for the 20,000,000 acres of wide prairie stretches ready for 1915 confidence and courage have increased everywhere in business circles."

Mainly Constructional

East and West—From Coast to Coast

The building permits issued at Vancouver during the twelve months ending December 31, 1914, totalled $4,484,000.

The ratepayers of Guelph, Ont., defeated the by-law to raise $125,000 for an addition to the Collegiate Institute.

Mr. George Powell, the Deputy City Engineer of Toronto, is having plans prepared for a new water-works system for the Township of Lambton Park.

The ratepayers of Niagara Falls, Ont., will be asked to vote at a later date on a by-law to raise $200,000 for sewer extensions. The City Engineer is Mr. F. Anderson.

From St. John, N.B., comes a report of the completion of the new dock for the ocean liners of the Canadian Pacific Railway Company. The work was carried out by the Maritime Construction Company.

The Toronto ratepayers have approved of a by-law to raise $425,000 for new civic car lines on Mount Pleasant Road and Lansdowne Avenue. This amount includes the cost of construction and equipment.

The Brantford ratepayers have approved of a by-law to raise $100,000 for extensions to the water-works system. The City Engineer is Mr. T. Harry Jones and the Consulting Engineers are Messrs. Chipman & Power, Toronto.

A post office and customs house, estimated to cost $225,000, is to be erected at Three Rivers, Que., and foundation work for the structure is now completed. The general contractors are Messrs. F. A. Verrette & Company, Three Rivers.

At Montreal, excavating is under way for a public library on Sherbrooke and Montcalm streets. The estimated cost is $200,000. The architect, Mr. E. Payette, Montreal, will call for tenders on the construction about the end of January.

The pulp and paper mill at Millerton, N.B., owned by the New Brunswick Pulp & Paper Company, was destroyed by fire last week at a loss of $150,000. The property was insured to the value of $125,000. Mr. J. Volckman is Manager of the firm.

Exterior work is in progress on the new Customs House which is being erected at Ottawa at a cost of $400,000. The building is to be seven storeys high, with basement. It will be of reinforced concrete, steel and brick construction. The general contractors are Messrs. Peter Lyall & Sons Construction Company, Limited, Montreal.

An addition to the University of Ottawa has been completed at a cost of $150,000. The fittings, however, are yet to be installed, and these will be purchased at an early date. The new building is four storeys high, 130 x 52 feet in dimensions, of Indiana limestone construction. The architects were Messrs. Meredith, Findlay & Hazelgrove, of Ottawa.

We have received from the Secretary, Mr. J. R. Wemlinger, of New York, a program of the forthcoming Convention of the American Society of Engineering Contractors. The meeting will take place on January 15th, in the United Engineering Society's Building at 25 West 39th Street. After the routine business of the Society has been transacted, a number of interesting reports will be submitted. In the evening, at seven o'clock, a banquet will be held at Bustanoby's Restaurant on Broadway.

Personal Mention

Mr. George Joseph Desbarats, Deputy Minister and Comptroller of Naval Service, is among the recipients of New Year honors. He has been made a Companion of the Order of Saint Michael and Saint George. Mr. Desbarats is a civil engineer by profession, and has superintended the construction of a number of canals, railways and other important public works, including the rebuilding and enlargement of the Government shipyard at Quebec. He was Acting Deputy Minister of Marine and Fisheries in 1908-10, Deputy in 1909-10, and Deputy Minister of Naval Affairs since 1910.

Mr. W. Matthews Jones, City Surveyor and Engineer for the City and Borough of Chester, is the new President of the Institution of Municipal Engineers of Great Britain. He is thirty-nine years of age, and was educated at the King's School and Technical Schools, Chester. After completing his articles with his father, Mr. I. Matthews Jones, M. Inst. C.E., F. S. I., he was appointed Assistant in the Surveyor's office at Chester, from which junior position he has become chief of his department. Among various important municipal works carried out under his supervision at Chester, mention may be made of the sewage purification works, which cost some $350,000. It may come as a shock to his Canadian confreres to know that Mr. Jones' services have met with the generous appreciation of his Council. On more than one occasion the city fathers of Chester have passed encomiums upon his general efficiency and his particular capacity for managing men.

Among the new Canadian Knights is Sir Herbert Samuel Holt, K.B., civil engineer, who is now chiefly known for his connection with many of the Dominion's foremost industrial companies. He was born in Dublin in 1856, and studied civil engineering in his native country. He came to Canada in 1875, and from that date to 1883 was engineer in charge of construction on several Ontario and Quebec railways. He was also engineer and superintendent of construction for the Prairie and Mountain sections of the Canadian Pacific Railway in 1883 and 1884; carried out extensive contracts in the Rocky Mountains, the Province of Quebec and the State of Maine, for the C. P. R., from 1884 to 1889; built two Mackenzie and Mann railways in the west, aggregating five hundred and fifty miles, from 1889 to 1892, and since then has devoted his whole time to financial and banking business. He is president of the Royal Bank of Canada, the Montreal Light, Heat and Power Company, the Montreal Trust Company, and the Kaministiquia Power Company, and director of the Cedars Rapids Manufacturing and Power Company, Shawinigan Water and Power Company, Canadian General Electric, and other concerns. Sir Herbert Holt is a member of the Canadian Society of Civil Engineers, and of the American Society of Civil Engineers.

The following lectures have been delivered recently before the Graduate Students in Highway Engineering at Columbia University, New York City:—December 14th, "The Construction and Maintenance of Cement Concrete Pavements," by Mr. Edward D. Boyer, of the Atlas Portland Cement Company, New York City; December 16th, "Specifications for Physical Properties of Paving Bricks and Stone Blocks," by Mr. Wm. A. Howell, M. Am. Soc. C.E., Engineer of Streets and Highways, Newark, N.J.; December 23rd, "Planning of Streets and Street Systems," by Mr. Nelson P. Lewis, M. Am. Soc. C.E., Chief Engineer, Board of Estimate and Apportionment, New York City; December 28th, "Production of Bermudez and Trinidad Asphalts," by Mr. C. N. Forrest, Assoc. M. Am. Soc. C. E., Chief Chemist, Barber Asphalt Paving Company, Maurer, N. J.

Trouble is likely between the Montreal Builders' Exchange and the Trades Unions consequent upon the reduced scale of wages decided upon and also the adoption of the open shop principle. Mr. J. Quinlan, one of the largest contractors, declares that he will pay the new rates while the unions state that in that case no union labor will be available.

Revised Wage Scale at Vancouver

The Secretary of the Vancouver Builders' Exchange furnishes us with the following revised wage scale of the building and allied trades in that city. This was adopted at a general meeting of the Exchange held on December 29th, when it was unanimously decided that the list should be placed upon a more reasonable basis. Except where otherwise stated, the wages apply to an eight-hour day: bricklayers, $5.00; bricklayers' helpers, $2.40; mortar mixers, $3.00; stone cutters, $5.00; stone masons, $5.00; plasterers, $5.00; plasterers' helpers, $3.50; tile and marble setters, $5.00; tile and marble setters' helpers, $2.80; building laborers, $2.40; excavating laborers, $2.00; metal lathers, $4.80; carpenters, $3.60; painters, $3.60; glaziers, $2.50; plumbers, $4.00; plumbers' helpers, $2.40; steam fitters, $4.00; steam fitters' helpers, $2.40; gas fitters, $4.00; sheet metal workers, $4.00; electrical workers, $4.00; structural iron workers, $4.50; hoisting engineers (steam), $4.00; hoisting engineers (electrical) $3.00; one man, horse and cart, $4.50 per nine-hour day; one man, team and waggon, $6.00 per nine-hour day.

Calendars

Morris Machine Works, manufacturers of centrifugal pumping machinery, Baldwinsville, New York City.—An attractive office calendar, with a picture, "In the Garden of Dreams," reproduced by photo color from an original painting by W. J. Whittemore.

York Sand & Gravel Co., Ltd., East Toronto, suppliers of screened sand, pit run screened gravel and pea gravel.—A large office calendar with bold numerals and a colored illustration, "In Nature's Playground," reproduced from a painting by Thomas Moran.

From the Northern Crane Works, Limited, Walkerville, Ont., we have received an illustrated booklet containing descriptions of various types of cranes and hoists manufactured by this firm. These well-known Northern cranes are built in Canada, under arrangements with the Northern Engineering Works of Detroit. Their design is identical with that of those turned out by the Detroit works, but, as far as possible, all workmanship and material are Canadian. The booklet is illuminating not only from the standpoint of manufacturing detail, but from that of actual application under service conditions.

The Canadian Bitumastic Enamels Company, Limited, Montreal, the agents for Wailes Dove & Company's "Bitumastic" materials, have secured the contract to clean and apply Bitumastic Enamel to the interior surfaces of the emergency intake water pipe for the city of Montreal. This pipe is approximately 1,400 ft. long by 8 ft. in diameter, and was built to prevent a water famine such as the city experienced in 1913. The American agents for the same materials secured contracts for the city of New York and the city of Baltimore.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Brantford, Ont.
The ratepayers of this city have carried a by-law to authorize the expenditure of $100,000 for the completion and extension of a water-works system for the city. Messrs. Chipman & Power, 204 Mail Building, Toronto, are the Engineers.

Essex, Ont.
A by-law authorizing the expenditure of $6,500 on water-works improvements has been passed by the ratepayers of this town. Mr. Charles Chase is the Mayor.

Ingersoll, Ont.
The ratepayers here have carried a by-law authorizing street paving work on Thames street. Mr. W. R. Smith is the Town Clerk.

Moose Jaw, Sask.
The City Council has had plans drawn for road grading on River Park Drive, estimated to cost $7,000. The work will include the building of two timber approaches to steel bridge, in addition to grading. The work is to be carried out by day labor under the supervision of Mr. J. C. Keith, City Engineer, Box 141, Moose Jaw.

Ottawa, Ont.
The Water-works Department of the City Council has decided to call for tenders for the supplying of castings for the Water-works Department during 1915.

Surface drainage work has been started by day labor under the supervision of Mr. F. C. Askwith, City Engineer. Tenders will be called for balance of work, which includes asphalt macadam pavement between Rochester and Preston streets.

The City Council has invited tenders for asphalt pavement work between Gladstone and Laurier, estimated to cost $21,000. Surface drainage has been commenced by day labor.

The ratepayers of this city have carried a by-law authorizing the carrying out of a water distribution system and the laying of cast iron water mains, estimated to cost $420,000. Mr. R. L. Haycock is Water-works Engineer.

The City Council will carry out sewerage work on Ottawa street, at an estimated outlay of $260,000. The necessary byllaw authorizing the expenditure was passed by the ratepayers at the January elections.

Port Dalhousie, Ont.
A by-law for a water-works system, estimated to cost $50,000, has been passed by the ratepayers of this village. Mr. J. M. A. Waugh, is Village Clerk.

Railroads, Bridges and Wharves

Alsask, Sask.
Alterations to station for the Canadian Northern Railway at Alsask, are to be completed by July 1st. Mr. M. H. MacLeod, Union Station, Winnipeg, is Chief Engineer.

Diltz Junction, Ont.
The Erie & Ontario Railway have approved of the location for a station at Diltz Junction. It is expected that the work will be proceeded with right away.

Enniskillen, N.B.
The Provincial Government Department of Public Works have had plans prepared for a new bridge to be erected in Queen's County. Tenders for the work will be called immediately. Mr. John Morrison, Fredericton, is Minister of Public Works.

Gloucester County, N.B.
Tenders for the construction of a bridge in Gloucester County will be called at once by Mr. John Morrison, Fredericton, Provincial Minister of Public Works.

Hutton, B.C.
Plans have been drawn, and the site has been approved by the Railway Board, for the construction of a station at Hutton, in Cariboo District, for the Grand Trunk Pacific Railway. Mr. C. C. Van Arsdol, B.C., is Division Engineer.

London, Ont.
The ratepayers of this city have declined to endorse a by-law providing for the construction of a $40,000 bridge across Richmond street.

Province of Alberta
Tenders are in for the construction of a large steel and concrete bridge across Big Smoky River, for the Edmonton, Dunvegan & B. C. Railway, St. Albert's Trail, Edmonton. It is reported that the contract is likely to go to the firm of McPherson & Quigley, Edmonton.

Province of British Columbia
Kettle Valley Railway Company have been authorized by the Railway Board of Commissioners to construct three bridges across Coquihalla River. Mr. A. McCulloch, Penticton, B.C., is Chief Engineer.

Province of Ontario
The construction of a spur on the land of Austin & Nicholson, Township No. 37, District of Sudbury, Ontario, for the Canadian Pacific Railway, has been authorized by the Railway Board.

Raleigh Township, Ont.
The township council has decided to start work immediately upon repairs to five bridges over Raleigh Plains Drain. The work will involve an expenditure of about $5,000. Mr. Jos. E. Doyle, Cross Street, Chatham, is Engineer-in-Charge. Mr. A. E. Robinson, Buxton, Ont., is township clerk.

Regina, Sask.
The Works Department of the City Council has been authorized by the Board of Railway Commissioners to have plans prepared for the construction of an overhead bridge across the C. P. R. tracks at Hamilton Street. The plans are to be submitted for approval to the C. P. R. Bridge Engineer and also the Railway Board. Mr. F. McArthur is the engineer.

Ribstone, Alta.
The Railway Board have plans and location for contemplated station to be erected by the G. T. P. Railway at Ribstone. Mr. F. T. George, Fitzhugh, Alta., is Division Engineer.

Sherbrooke, Que.
The construction of about five miles of light railroad for logging purposes is contemplated by C. H. Swift & Sons, Utica, N.Y., and Sherbrooke, Que. The Company's requirements will include a second-hand five or ten-ton locomotive, also a supply of cars for logs.

Salmon River, B.C.
Plans have been prepared by the Provincial Government Department of Public Works for the construction of a permanent bridge at Salmon River, St. John County. Tenders for the work will be called at once by the Department.

Tiny Township, Ont.
The Grand Trunk Railway have been authorized to construct a bridge across the road between the third and fourth concessions, near Wayville. Mr. H. A. Palmer, Toronto, is Assistant Engineer.

Toronto, Ont.
The Board of Railway Commissioners has ordered that the City make the superstructure of Keele Street subway waterproof. Plans for the waterproofing are to be filed with the Board of Control for approval.

The ratepayers of this city have passed a by-law for the construction of civic car lines extending from Ranleigh Avenue to Shaftsbury, Mount Pleasant Road, at an estimated cost of $320,000; also from St. Clair Avenue south on Lansdowne, at an estimated cost of $105,000. These amounts include the cost of construction and equipment. Mr. R. C. Harris is Commissioner of Works.

Victoria County, Ont.
The County Council has in contemplation the building of a bridge, estimated to cost $5,000. Messrs. Smith & Smith, Colborne street, Lindsay, are the Engineers.

Public Buildings, Churches and Schools

Alliston, Ont.
Work is to commence as soon as possible on the construction of a reinforced concrete and brick church building for Knox Presbyterian Church. The building is to be erected on the site of the old church, for the purchase of which tenders have been called. Mr. W. A. Aus-

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Inefficiency in Architectural Practice

IN the many dictionary definitions of an architect, we find the highest common factor of description to be, "one skilled in the art of building." The Webster amplification of this is, "one who makes it his occupation to form plans and designs of, and to draw up specifications for, buildings, and who superintends their execution." There is common agreement that the essential attribute of an architect is "skill in the art of building."

Taking such skill as something more than a superficial knowledge of design, one is tempted to ask what is the proportion of the architectural profession in Canada possessing it. The question arises out of the unsatisfactory performances of the profession as revealed in the Courts. The evidence offered in these cases would appear to indicate that many architectural practitioners in Canada to-day are not only insufficiently versed in what constitutes sound building construction, but that they lack the mental and moral attributes which should impel them to quick decisions in condemning inferior materials and workmanship. They sidetrack the terms of the contract and rely too much upon the contractor, who more often than not is the member of a select family party with whom, perforce, the architect must maintain good relations.

These observations are not intended to constitute a wholesale criticism of architects, but rather to point the shortcomings of those who are bringing the profession, or business, into disrepute.

Architects would appear to number in their ranks many types of inefficients. One of these is the "artist" type—individually, perhaps, a graduate of some European school of design, and a designer in the superficial and more elaborate sense. Such a man is often quite accomplished in things aesthetical, but in ninety-nine cases out of one hundred he is sadly lacking in things practical.

There is all the difference between an "artist" and "one skilled in the art of building." In this connection it may be of interest to quote the following extract from a recent judgment:

> "To some extent an architect is an artist—that is, as regards the design and plan. But for the rest, his work is just ordinary tradesman's work—drawing specifications and supervising the work. He is not supposed to do all the supervision personally. His subordinates can do much of it as well as he can himself, but if he undertakes to do it, he is bound either to do it himself, or to have it done by some person whom he employs and in whom he has confidence. I think the meaning of the contract is that he shall see that the work is done well before he certifies it. If he does not do this then the interest of the employer is altogether neglected."

In a considerable proportion we have the practical but self-made type—often a man who has risen from the ranks, one whose acquaintance with design is limited, but who can make a fairly sound job of a structure on simple lines. This type is less dangerous than others, but it is hardly creditable to the profession.

Then there is type No. 3—(we say this gently) the all-round inefficient and not wholly scrupulous type. It is not always wise to call a spade a spade, but there are times when the word shovel would be misleading. We cannot disguise the fact that there is the architect who "fixes" it with the contractor and who conducts his business on the "one client-one job" principle, making the most of his opportunities accordingly.

This, perhaps, is the most dangerous type. He cannot be relied upon to make an honest selection from the firms tendering, and the fairest building contract under his enforcement is jeopardized in its every clause. Attributes of this type of architect are indefiniteness in plan and looseness in specification, as a result of which unfair difficulties arise during the erection of the building.

The least familiar type of architect is the all-round efficient practitioner who combines with a sound knowledge of design and construction an intimate experience with economic building supervision—and a command of contractors. All of which, in the sum total, makes for expeditious work executed and delivered according to the letter of the contract and specifications.

The efficient man, then, is one of four types. From this it must not be inferred that the "all-round efficient man" represents twenty-five per cent. of the profession. We believe it to be a conservative estimate that Type No. 3, to whom we have referred above, himself occupies fifty per cent., leaving, perhaps, the other types in equal proportions of less than seventeen per cent. of the whole.

Let us consider, then, that we are concerned mostly with Type No. 3. Upon this type in general we would impress the fact that he is employed both for sound design and sound construction, and that he is legally responsible to his employer for shortcomings in this regard. Let us continue.

A fruitful source of trouble is the manner in which the architect certifies payments to contractors. We have a case in mind (Irving v. Morrison, U.C.C.P. 242) in which the architect brought an action against his client to recover money for his services as architect in connection with the erection of the defendant's house. As a result of the architect's having certified payments in wrong proportions, a considerable sum had been overpaid certain contractors. These contractors failed before the completion of their work and their contracts had to be re-let at a higher figure. In awarding judgment the Court gave the client authority to deduct the amount of such loss from his payment for the architect's services.

From time immemorial "extras" have spelled trouble between the architect and the building owner, and there would appear to be little amelioration thereof. The duties of the architect in regard to "extras" are defined (see Hudson on Building Contracts, 3rd Edition, Vol. 1, p. 77) by stating that the architect should:

> "(1) obtain instructions from his employer as to extra work or deviations, unless he has power under the contract to order what extras or variations he pleases without reference to his employer; (2) see that none are undertaken without orders in writing, signed by him, and countersigned by the employer if required by the terms of the contract; (3) not certify for payment of any extras or deviations executed without proper orders; (4) not order as extras, or certify for as extras, works indispensably necessary to complete an entire contract."

Of recent years such slip-shod practices have crept into the architectural supervision of building construction that opinion as to the responsibility of the architect in this connection is in a very nebulous state. But in this regard, as in the case of many other troubles which seem to have become accentuated in recent years, the law has many well-established precedents. For instance, we recall an action (Leicester Guardians v. Trollope, 75 J.P. 197, Channel, J.) in which an architect was sued by a public body and shown to be liable for dry rot which broke out in the floors of a new building four years after its completion. The floor was laid over concrete, and the defendant was shown to have been negligent in permitting faulty construction.

The Province of Quebec holds the architect responsible for defects in buildings for a period of no less than ten years. In one case (Scott v. Christ Church Cathedral, 1 L.C., L.J. 65) this liability was maintained despite the fact that the architect against whom judgment was awarded had taken over the work from another architect and assumed charge subsequent to the preparation of plans.

Quebec provides us with another case (David v. Macdonald, 8 L.C. Jur. 44, 14 L.C. Rep. 31) where the architect and contractor were held jointly responsible to the owner for damage incurred in the sinking of the floors of a building occasioned by the insufficiency of the timbers specified.

Only the other day, in an action brought by Mr. Colborne Meredith against the Roman Catholic Episcopal Corporation of Ottawa, to recover fees in connection with the erection of a parish house, Mr. Justice Middleton scored the plaintiff for not insisting upon the construction of the roof as laid down by contract. His Lordship characterized the work as a "botched job," and decided that the architect would have to compensate the owner for the work of reconstruction.

Our criticism of Type No. 3 is surely exemplified by the cases cited above. We have nothing against the efficient architect, who is laboring in such a small minority: our opposition is to the unbusinesslike—if not unprincipled—characteristics of the professional misfits that are figuring so largely and prominently in the Courts to-day. In using the term "unbusinesslike" we follow the precedent of no less an authority than Mr. Justice Falconbridge, who employed it in a recent judgment.

Thus we find the work of the most common type of architect characterized by lack of foresight and lack of care, reflected in indefinite specifications and an altogether inadequate appreciation of the fundamental responsibilities of the profession. Such inefficiency is a prolific multiplier of those "extras" which are the bugbear of the building owner.

It is time for the really sound members of the architectural profession to examine into the conditions which admit these inefficients into their ranks. The architectural profession in Canada is the architect of its own fortune. If that fortune is not to be dissipated, higher standards will have to be put into force at no distant date. Otherwise we shall find the ancient and honorable profession of architecture superseded by a struggling class of hired designers, the actual responsibility for whose work will be divided up amongst industrial engineers and other specialists who will enter the field and thrive in it.

Other phases of architectural inefficiency will be discussed in a later article.

An Architectural Competition for the Australian Parliament House, on the site of the new federal capital of Australia, has been announced. Designs must be delivered in London or in Australia by March 31, 1915. Prizes totalling £6,000 are offered, the first prize being £2,000. The judges are: Mr. George T. Poole, of Australia; Mr. John James Burnet, of London and Glasgow; Mr. Victor Laloux, of Paris; Mr. Louis H. Sullivan, Chicago, Ill.

Western Optimism

MR. G. Silvester, of Calgary, paid a visit to the office of the Contract Record last week. Mr. Silvester, who was about to return to Calgary, had been in the East for some few weeks, following a visit to Dayton, Ohio, where he attended the Annual Convention of the Sand-Lime Brick Manufacturers' Association.

In the course of conversation with one of the editors of this journal, Mr. Silvester showed characteristic Western optimism. He is persuaded that the setback in business which we are experiencing will redound ultimately to the advantage of the country. He believes that during the present lull in constructional activities we should set our house in order to meet the demands which will come with the rush of immigration from the European countries at the close of hostilities. Mr. Silvester is confident that this flood of immigration will beat all previous records. He says that Canada will be the most natural country to which the over-taxed people of the European countries will turn, and that the application of their high mechanical development to Canadian industries will mean much for many of our trades.

Mr. Silvester is Manager of the Calgary Silicate Pressed Brick Company, Limited. He is Vice-President of the Local Builders' Exchange of Calgary, and President of the Provincial Builders' Exchange of Alberta.

Inscriptions on Engineering Structures

IT has long been the custom to place inscriptions on engineering structures, either on corner stones, on stones over main entrances to buildings, or on metal plates, placed on the end posts of bridges or on the inside walls of buildings. The custom has not been general by any means, but it should become so.

There are substantial reasons why this custom should become general. In the first place there is the item of public interest to be considered, and in the second place the fixing of individual responsibility. The official name of every important engineering structure should be permanently inscribed at some conspicuous point on the structure's exterior. This is for the information of citizens, particularly of visitors who have occasion to inspect the public works of a city. Moreover, this appears to be a suitable and efficacious method of calling the attention of the public to the work of engineers, a consideration of great importance to both engineers and laymen. To illustrate our thought in this matter, let us take the case of a modern rapid sand water filtration plant. The official name of the plant should be cut into the stone over the entrance to the head house or administration building. Inside the same structure a metal plate bearing appropriate data, in raised letters, should be prominently displayed on a wall. The data given should comprise the dates significant in the history of the inception and construction of the plant. The names of the city officials who had to do with the plant's installation should also be given, as should the names of consulting engineers, resident engineers, architects and contractors engaged upon the design and construction of the plant.

The fixing of responsibility for the structure in this manner is sure to have a salutary effect upon its serviceableness. What is probably more to the point, in most cases it will give credit for the work to those to whom credit is due. The public is quick to forget the names of its servants unless they are kept before it in some manner.

Incidental to the foregoing matter we take this opportunity to record a protest against the use of the letter v for the letter u in such inscriptions. The architect frequently collaborates with the engineer in the design of engineering structures of which buildings form a part. He brings his entire "box of tricks" along with him, including the alphabet from which the perfectly good letter u is missing. The origin of this custom is doubtless familiar to our readers; we are not concerned with its origin, however, but with its finish. It is a custom which has nothing to commend it. At best it is only a superficial indication of a certain form of culture. It causes momentary confusion to the reader, and if he be a plain man, and most readers are plain men, it causes him a certain feeling of irritation. —Engineering and Contracting.

"Capturing Trade"

A correspondent of the Building News (London) sends that Journal a hot criticism which is not altogether inapplicable to certain phases of our own industrial development at the present time. He writes:

"Many people speak and write about 'capturing German trade,' as if it were a merchantman just off the coast, which could be taken by one of H. M. gunboats. Trade really means the exchange of services, and if your correspondent desires to put this question to the test, let him consult recent files of the newspapers, and see what dyers, glass manufacturers, and others think about the subject. As a matter of fact, in the light of recent experience, the idea of 'capturing German trade' has really become a back number.

" . . . . . Manchester is rapidly becoming stagnant through the paralysis of the cotton trade. It is ridiculous to talk of 'capturing' a foreign trade when we cannot retain our own trade. The lessons your correspondent and many others have to learn is that we have paid a great deal too much attention to matters abroad and neglected—criminally, in my opinion, neglected—our own home affairs. If 'the man from Mars' could (unintercepted by the censor) pay us a visit, whatever would he think of the silent mills and workshops, whilst millions of people are going without adequate clothing; or of the warships convoying food across the seas with half the land of England lying derelict? Here is plenty of trade to 'capture.'

"And the result of our neglect? Let the closed exchanges give the answer. Building up 'our' foreign trade on paper that the first breath of adversity scatters. The 'paper merchants' of Manchester and Liverpool are now endeavoring to 'get on the taxes,' and it looks as if they would succeed The wise man of old was right: 'The eyes of the fool are in the ends of the earth.' When we build our trade as most of your readers build their houses—for home consumption—we shall arrive. Then the Kaiser will have nothing to fight about."

Dr. Rudolph Hering, the author of an interesting paper published in this issue, was the recipient, a short time ago, of a letter from the German trenches—written by Dr. Karl Imhoff, the inventor of the two-storey sewage settling tank which bears his name, and which is well-known in Canada. Dr. Imhoff informed Dr. Hering that Dr. Spillner, one of his associates who had been in charge of the chemical work at Essen, had fallen in battle. Readers of the Contract Record will join us in the hope that a similar fate will soon overtake the inventor of the two-storey settling tank—despite his undoubted ability as a designer.

Bird's-eye view of the Canada Wire & Cable Company's plant at Leaside (Toronto) as it will appear upon completion.

The Canada Wire & Cable Company's New Plant at Toronto

(Staff Article)

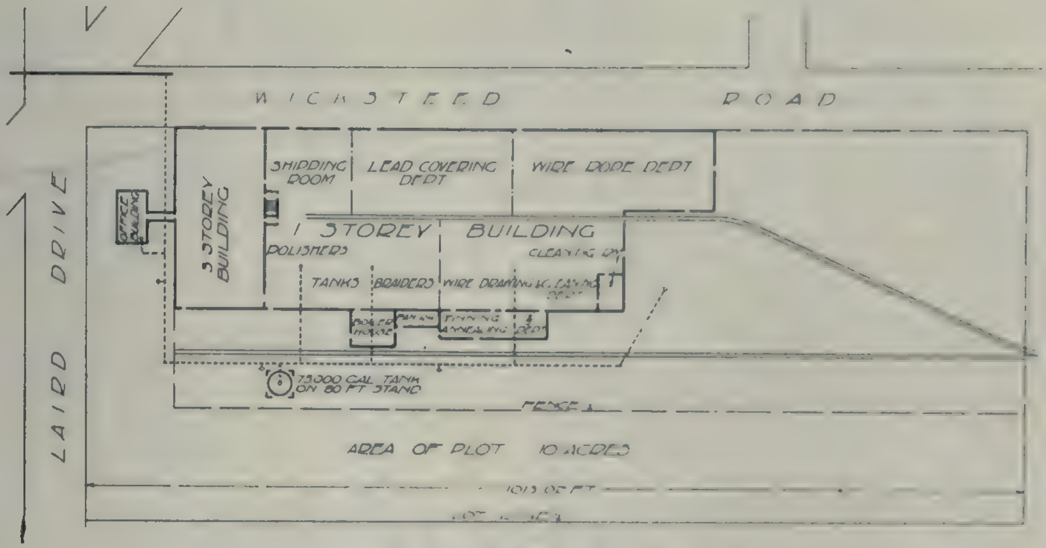
THE new plant which the Canada Wire & Cable Company, Limited, of Toronto, is erecting at Leaside is rapidly approaching completion. Before deciding on its location, a careful study was made of the various available properties in and near Toronto, as it will be appreciated that for a business such as this, convenient railroad accommodation must be obtained, as well as satisfactory trucking facilities to provide for the city trade. These features are fully realized in the present site, which consists of a ten-acre lot on the corner of Wickstead Road and Laird Drive, within half a mile of the main line of the Canadian Pacific Railway, from which a siding has been constructed. Later on a similar connection will be made to the Canadian Northern Railway, who propose constructing their line adjoining this property. The site is within three miles of the centre of the city and according to present indications it will be only a question of a year's time when Leaside will form a portion of Toronto proper, as plans are being formulated already for the construction of a car line to connect this suburb with the city system.

In its new quarters the Canada Wire & Cable Company, Limited, will be fully equipped to manufacture a complete line of bare and insulated wire and cables, in both copper and aluminium, for the electrical trade, including telephone and power cables. It is also the intention of the company to manufacture steel strand guy wire and a complete line of steel wire rope.

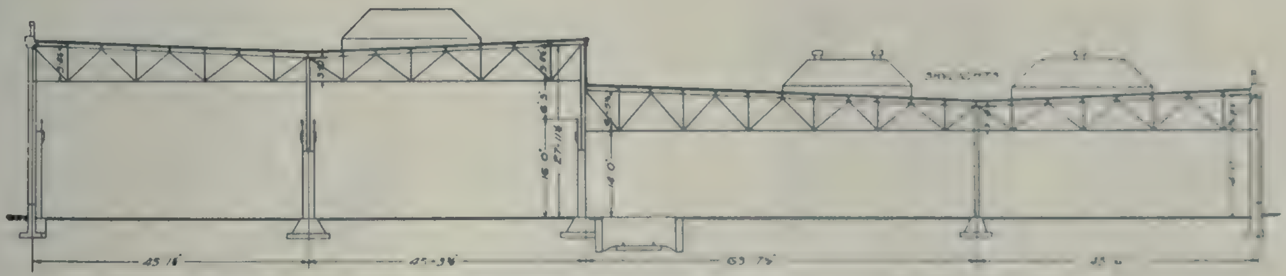
The plant has been designed with the idea of obtaining a maximum of efficiency in the handling of all materials. In general, it consists of a building 600 ft. long by 200 ft. wide, with annexes on the south side for boiler, fan, tinning and annealing rooms. The western portion of the building, which is 100 ft. by 200 ft., is three storeys in height. It is of mill construction, with heavy timber framing and 3-in. plank sub-floors, a typical cross section of which is shown in the illustration.

The remaining portion of the building is one storey high with plank roof, supported on steel purlins, trusses and columns, as illustrated by typical cross section. It will be noted in regard to this one-storey structure, that crane runways are provided for the two bays on the north half of the building, from which electric cranes will handle heavy reels, etc., and facili-

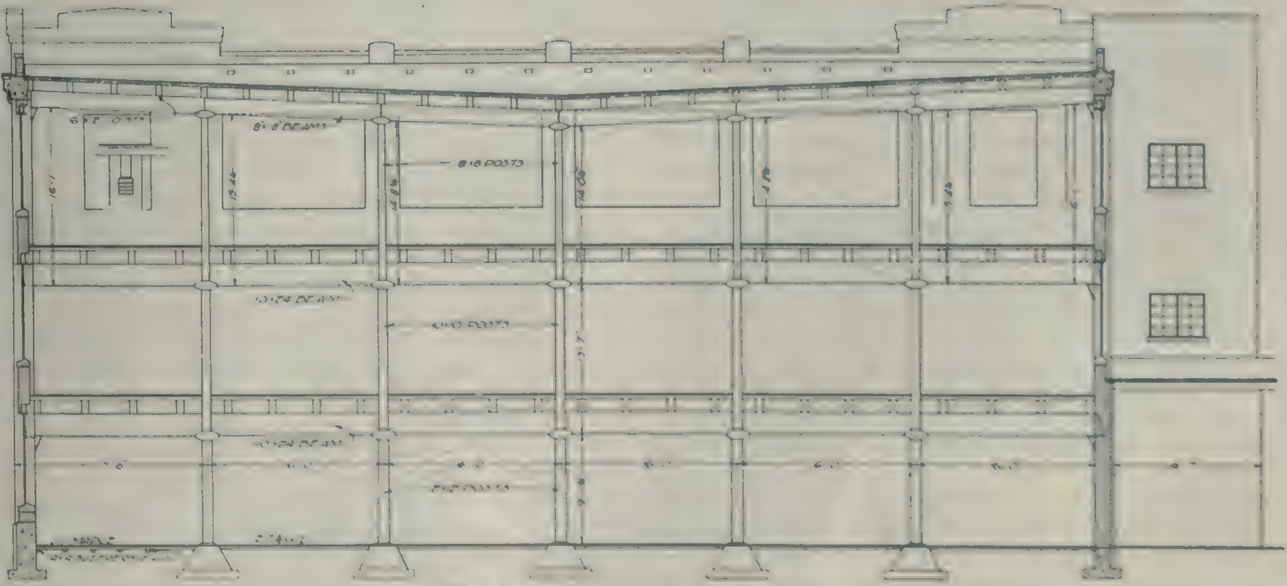
Canada Wire & Cable Company's plant under construction.



General plan of the Canada Wire & Cable Company's new plant.



Cross section through one-storey building.



Cross section through three-storey building.

tate the handling of materials, and the loading and unloading of waggons which may enter the building through the shipping doors. In this building the railroad track enters at the east end and extends through the middle of the structure, as shown. It is depressed to a depth of four feet below the finished floor, with a concrete retaining wall on either side, thereby allowing the floor of the cars to come level with the factory floor. A car-hauling equipment consisting of a motor-driven winding engine and cable will be installed to handle the cars inside the building, thus obviating the necessity of moving them by hand. The various manufacturing departments are arranged on each side of the track. At the same time easy access is obtained to the electric motor-driven elevator which serves the three-storey building in the position shown. With this building the main stairway is combined.

The walls of all the buildings are of brick. Special care has been taken to provide maximum window and skylight space in order that a satisfactorily lighted interior may be obtained. The windows are of steel and furnished by the A. B. Ormsby Company, Limited, of Toronto, who have likewise supplied the skylights. The latter are heavily constructed of galvanized iron, glazed with ¼-in. wire glass and provided with 16-in. Ormsby-Swartout ventilators. The glass used for the windows is ⅛-in. factory ribbed. The roofing consists of standard five-ply Barrett specification felt and gravel.

The two-storey brick office building, 35 ft. x 60 ft. in plan, is likewise of mill construction and is placed west of the three-storey structure, to which it is connected by a covered passage way.

A direct radiation vacuum heating system, consisting of cast iron radiators, pipe coils, etc., will be installed in the three-storey factory and office buildings, whereas the one-storey structure will be heated by means of an indirect system consisting of underground concrete heating ducts, through which hot air will be forced by means of fans, heaters and engines, furnished by the Canadian Sirocco Company, Limited, Windsor, Ont. These ducts are arranged to extend along the walls of the buildings from which cored openings in the foundation walls will deliver the heated air through registers just above the floor line.

The entire plant will be equipped with a complete fire protection system in accordance with the requirements of the Canadian Board of Fire Underwriters. The whole consists of the necessary yard piping with hydrants, post indicator valves, etc., and complete sprinkler system, including a 75,000-gallon steel tank on an 80-ft. tower.

The various machines comprising the manufacturing equipment will be arranged for independent motor drive or combined in groups, each group having its own motor. Detail machinery layouts have been very carefully arranged, special study being required in order to obtain the most satisfactory methods of operation. Reynolds silent chain drives will be used in all cases where practicable, and the motors in many cases are supported on concrete pedestals or hung from the roof trusses.

The lighting will consist of a combination of tungsten, arc and nitrogen lamps of various sizes controlled in groups from panel boards. Each of these will be wired to the main switchboard, located in the electrical room adjoining the fan house. Electricity for power and lighting will be furnished by the Hydro-electric Power Commission of Ontario, who will install the main transformers in a separate building on the south side of the property. The site will be convenient to the switchboard room.

In studying the Leaside location it was decided that it would be advantageous to provide living accommodation for the company's employees. As part of the present undertaking the company is therefore constructing one hundred workmen's houses in locations convenient to the plant. These houses will have concrete basements, brick walls, and will be of substantial and attractive design.

The entire plant has been designed and constructed by Mr. E. A. Wallberg, C. E., Engineer and Contractor, of Toronto and Montreal. The structural steel in the building was supplied by Messrs. McGregor & McIntyre, Limited, Toronto.

A Balanced Cantilever Bridge*

By Henry H. Quimby†

THERE was constructed and opened to travel about a year ago a bridge that is believed to be of a new type, and that is of interest as such, besides presenting a means of obtaining a much desired class of structure where otherwise it would be impracticable. The design as worked out proved to be economical in cost of construction, and the bridge is quite rigid under traffic, and is an admired ornament to the locality.

It is in appearance a concrete arch, but in reality is composed of two balanced cantilevers which are theoretically independent of each other in action, being connected simply by a short suspended span over the channel, each cantilever being in itself stable over a single pier without assistance from the other, and without anchorage.

The bridge is in the city of Chester, Pennsylvania, carrying Fifth Street over the Chester River. Its length is 160 ft. over all, with main span of 95 ft. centre to centre of piers, and wings or shore overhangs of 31 ft. and 34 ft. respectively. It is 60 ft. wide with cartway of 36 ft. between curbs.

The peculiar design was adopted because of the desire of the authorities for not only an open deck but an ornamental arch bridge at this point, while the sub-surface conditions were such as would make the construction of a real arch very costly. Also as the river is navigated past this point it was desirable to have a thin floor at the middle of the channel without humping up the street grades.

These sub-surface conditions consisted of deep soft mud on one side of the river with the hard rock bottom sloping steeply away from the channel, so that even if an arch abutment had been carried down to it, skewback steps would have had to be cut in it to prevent sliding (because of the structure of outcroppings in the neighborhood) to be seamy and untrustworthy for dependence against sliding. Also, the authorities who paid for the bridge are not the local municipal government, and are by law restricted in their jurisdiction and responsibility to the extremities of any bridge that they construct. Therefore, they were not responsible for either the construction or the maintenance of the street approaches to the bridge and were not called upon to provide retaining walls beyond the bridge proper to maintain the banks of the approaches. This consideration is of importance because the stream bends so as to flow nearly parallel with the street on one side, and a retaining wall abutment wing, to be of use as such, would have had to be very long, and in the deep mud would have been very expensive.

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* Presented before Section D of the American Association for the Advancement of Science at the Philadelphia Meeting, December 30-31, 1914.

† Chief Engineer, Department of City Transit, Philadelphia, Pa.

The bridge was built by the authorities of the County of Delaware, and the approaches, which are the bed of Fifth Street, are within the jurisdiction of the authorities of the city of Chester, which is in Delaware County.

The principle of the balanced cantilever is that of the double cantilever gantry crane, where the load travels from one side to the other of the support, the varying position of the live load shifting the centre of the gross pressure on the pier to one side or the other of the middle of the pier. If the range of shift is not more than one-third of the width of the support —one-sixth either way from the centre—there will not be any uplift or tension at the edge, and the extreme intensity of pressure on the loaded edge will not be more than twice the average over the whole width, and the heavier the dead load is in proportion to the live load the less the eccentricity of the combined load can be. This bridge was designed so that the dead load balances just at the middle of each pier with equal moments from both sides, and the greatest possible eccentricity of live load either on the wings alone or on the span alone, will shift the centre of gravity of the combined live and dead loads less than the limiting one-sixth of the width. The maximum eccentricity occurs with the greatest concentration on the extreme end of a wing when there is no live load on the span.

The structure is designed for heavy street loads—two street railway tracks each covered with fifty-ton cars, and vehicle loads on the shoulders averaging one hundred pounds per square foot, or concentrated to fifteen tons per axle. The sidewalks were designed in contemplation of the possibility, not infrequently realized, of an automobile leaving the cartway and traversing the sidewalk. The floor of the cartway is of concrete jack arches turned between the ribs, and the sidewalks are rod reinforced concrete slabs.

The deep mud on the east side of the river called for pile foundations to the pier on that side, while on the west side the rock is so near the surface that a thin concrete bed laid on it was all that was needed. The foundation concrete in each pier was regarded as dead weight and was anchored to the superstructure with embedded vertical steel rods to get the benefit of its effect on the shifting centre of gravity of the mass.

The east pier was made sixteen feet wide in the direction of the axis of the bridge to ensure a width three times as great as the shift of the centre of pressure on it. The piles, which were of wood, were driven to rock, but because of the softness of the mud stratum and the shallowness of the gravel over the rock, the loading of the piles was limited to sixteen tons per pile of the outer rows under greatest eccentricity. Spur or batter piles were driven on both sides and both ends to prevent lateral displacement, but they were not assumed to carry any vertical load.

The mud, being soft, gives very little lateral support to the piles which become, therefore, unbraced columns. In order to give them fixity at the top and reduce their tendency to buckle under load the concrete capping was cast around the upper three-feet of their length, and it was tied to them with embedded steel rods hooked around the outer piles to prevent the concrete cracking away on the line of the outer row.

The concrete ribs are ten in number and are twelve inches thick, and are reinforced with steel—both rivetted structural members and embedded rods in combination. The rivetted trusses were made only strong enough to carry the weight of the forms and the soft concrete of the ribs, no falsework being used on the job. The rods comprised nearly one-half of the tension reinforcement of the ribs.

Transverse diaphragms of concrete, six inches thick, reinforced with rods, were cast at four points in the span to act as distributors transversely of concentrated loading, and the counterweights at the ends of the wings, which are three and one-half feet thick, are reinforced in the same way and for the same purpose, as well as for the purpose of suspending them from the ribs. They were designed so that the load from one street car track will be distributed over four ribs, or the load of the two tracks distributed to and carried by the eight interior ribs. Transverse walls two feet thick along each edge of each pier serve to complete the lateral distribution if any more should be needed. The diaphragms are useful also as diagonal braces for the ribs.

The ribs are spaced so as to take the rails of either one track or two tracks, and only vehicle traffic will come on the jack arches which have a crown thickness of six and one-half inches. Their thrust is transversely of the bridge, and is resisted by structural steel ties at intervals across the whole width, the sidewalk slabs acting as horizontal beams in gathering the thrust to the ties.

The suspended span between the two cantilevers consists of a twenty-foot length of one of the cantilevers. It is, therefore, continuous with it and in fact is suspended only from the other cantilever. This continuity of the flanges modifies to some extent the cantilever action, but it does so only to a very limited extent and was designed to contribute to rigidity. In placing the trusses in erection they were adjusted on their bearings so as to divide the initial load of the suspended span equally between the two cantilevers. This was accomplished by wedging under the east trusses, which were the continuous ones, until the weight of the ends resting on the seats at the ends of the west trusses was one-half of the weight of the suspended span, as determined by testing with a lever of convenient proportions.

The concreting of the ribs was done in two stages, a pair of steel rods being embedded at the top of the first stage in each rib to create preliminary cantilevers that absorbed initial stress from the subsequent concreting, and did so at a point that does not get the maximum stress from full load. Care was taken in placing concrete to keep the growing load approximately symmetrical over the piers.

The theory of the design of this bridge is that the two cantilevers are independent, and the construction carried out the theory by leaving an open joint in the floor where the two ends came together, but apparently the push of the earth fill against the piers holds the joint tightly in contact, and produces a certain amount of real arch action in the arched span. The joint has not opened so much as a visible crack even in the coldest weather. It was made by lapping gussets between the ends of the trusses and bolting through slotted holes to permit movement in temperature changes. Heavy steel angle dams were provided, against which to finish the floor concrete. It would seem from the experience with this case that the joint with play for movement was an unnecessary refinement in the design.

A cantilever is inherently more flexible and less rigid than a braced arch or than even a simple truss,—because the flange stresses are acting throughout a longer line with consequent greater stretch and greater shortening of flanges,—for the same reason that a long beam will deflect more than a short beam under the same fibre stress.

Also in the case of this bridge the transit of the centre of gravity forth and back from one side to the other of a pier constitutes a rocking force, and might be expected to appear as an influence causing some horizontal movement in the pile pier. There is, however, no perceptible effect under the loads to which it has as yet been subjected and the structure is as rigid as a real arch.

As the lower edges of the ribs are compression members, and the river craft are heavy barges floated up and down stream on the tide, which runs fast at this point, it was desirable to protect the ribs against collision, and this was done by constructing a six-inch thick rod-reinforced concrete slab sheeting between the ribs, half way up from the spring, making a smooth soffit that the corners of scows cannot engage, and that also very effectively braces the ribs.

The parapets are open balustrades of concrete faced with a fine concrete or granolithic mixture which was finished by scrubbing with brushes and water when only partially hardened. The texture and tone that resulted resemble hammer dressed granite, and the surface is not subject to hair-cracking, efflorescence or discoloration, and is rough enough to discourage the practice of pencilling on it by idlers.

A gallery space was constructed under each sidewalk for the accommodation of water and gas mains and electrical conduits.

The cost of the bridge, exclusive of inspection, was $33,000, or $3.43 per square foot.

Constructional Features of the New Concrete Swimming Pool at Banff, Alta.

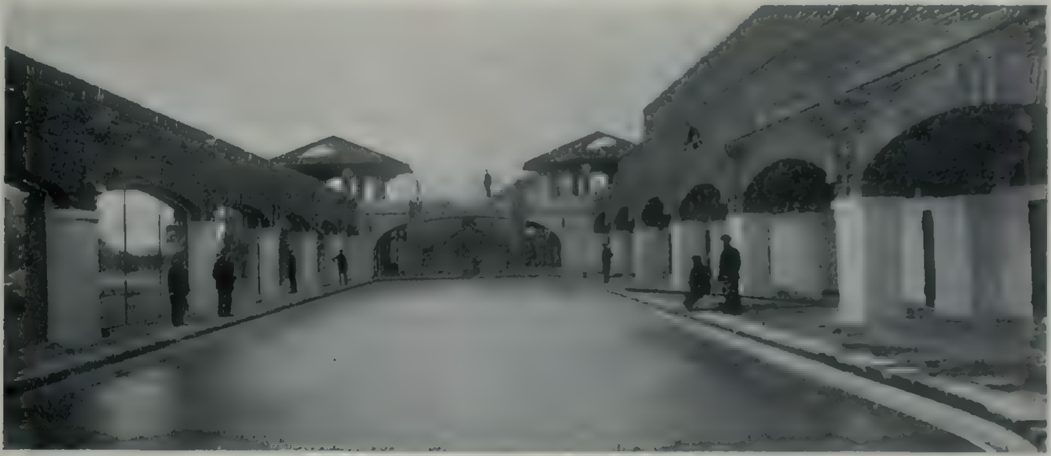
(Staff Article)

THE new concrete swimming pool and bath house for the Dominion Government at their lower sulphur spring at Banff, Alberta, has been completed. For some time the National Park Commission has maintained wooden structures at the well-known Cave and Basin Pool and the new, permanent, structure is the first element of a comprehensive scheme for the development of the attractions of the Banff National Park. Mr. Thomas H. Mawson, F.R.I.B.A., the eminent town planning authority, has been retained to prepare the general scheme for developing this Park along definite lines. While this first structure had its inception before that time, it has been incorporated into the broad scheme for the development of a large portion of the immediate vicinity.

The pool occupies a site on the side of the Sulphur Mountain, where there is a large spring of sulphur water rising out of the mountain side. In the course of time a large cavity has been developed in the earth, forming a small cave, the walls and roof of which are impregnated with sulphur, and a basin, exposed to the open air. The present construction embraces a long swimming pool, with bath house in connection, lying parallel to the mountain side, one end abutting the Basin, the other end covering a tunnel entrance to the Cave. It was the intention at a later date to cover the Basin with a large open belvidere, forming the axis to the completed pool and to another pool to be built on the opposite side. Two small belvideres at either end are to serve as terminals to the scheme.

Owing to the condition of the earth upon and against which the bath house is erected, there are unusual features connected with the design of the reinforced concrete. The structure is built upon a bench excavated in the mountain side, 4,575 feet above sea level, and about two hundred feet above the bottom of the Bow River Valley, commanding an excellent view of that world famous spot. The swimming pool lies parallel to the slope, and against the mountain side is the bath house, which acts as a retaining wall. At the far end from the basin is a two-storey structure composed of two octagonal belvideres 37 ft. in diameter, for use as shelters, and for the office, and from which access is had to the Cave through a tunnel. The swimming pool has a length of 150 feet, is 35 feet wide, and has a minimum depth of 3 feet and a maximum depth of 8 feet. The sides are formed by light reinforced concrete retaining walls, lined with white enamelled brick and finished at the top with a terra cotta scum trough and hand rail. The bottom is a reinforced concrete pavement on an asphalt base. The bath house has a length of 137 feet, a width of 27 feet, and a height of 40 feet. The roof is to be used as a promenade, and also to provide daylight to the dressing rooms, and consists of about 4,000 square feet of Luxfer prism lights. To soften the light from the prism roof, and at the same time protect the prisms from the steam arising from the bathers, there is an arched diffuser sash over the dressing room, with openings from which the air and steam are removed by a fan. All artificial lighting is placed behind this diffuser sash also. There are a total of 132 individual dressing rooms in the bath house, with toilet facilities and fresh water showers, the dressing boxes being built of Keene's cement on metal lath partitions. Outside the pool there is an arcade filled with plate glass windows, acting as a wind break for the pool. All the windows in the lower storey of the shelter are large plate glass windows; the upper storey is entirely open. The entire construction is of concrete, reinforced against temperature stresses and such loads as have been assumed to come upon the structure. All outside wall surfaces are veneered with local blue limestone, the thin stretcher courses, with deep raked joints, contrasting pleasantly with the smooth surfaces of the concrete. With the exception of the cement floor in the bath house, all floors are laid in patterns of red quarry tile, with cement borders.

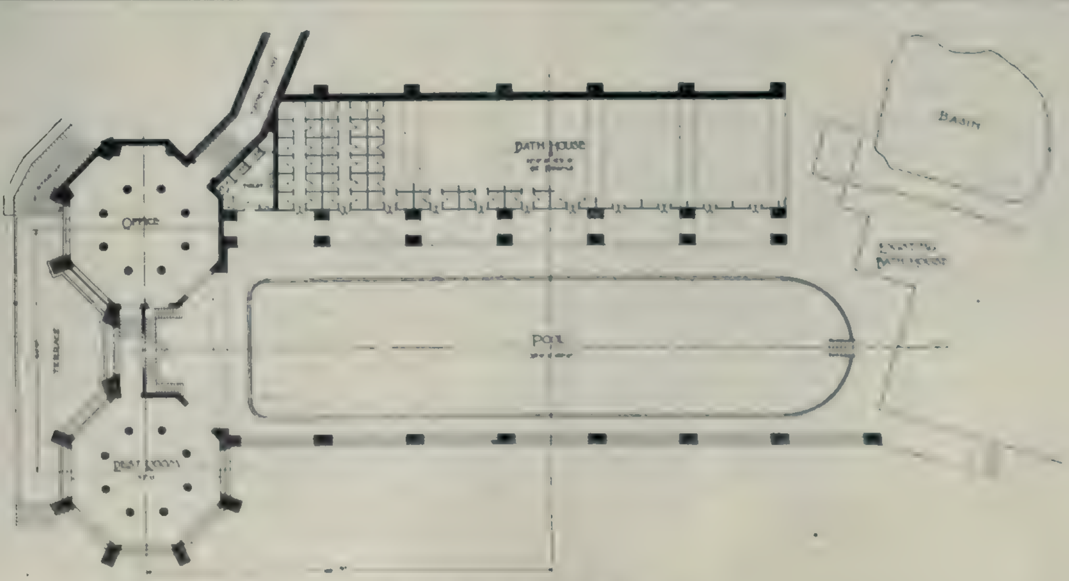
The foundations rest on piles, driven to refusal, and consist of reinforced concrete mattresses. Near the bottom of the excavation, quicksand was encountered, and a total of about 300 piles, 25 feet in length, were



The Government swimming pool and bath house at Banff, Alta.

driven through this strata. Approximately 1,700 cu. yds. of semi-rock was removed. The principal feature of the structural design was the method of retaining the rear wall of earth against which the structure was set. The condition of the foundations did not warrant the usual design of retaining wall, but instead, the thrust of the sodden earth is carried forward from the rear wall, into heavy buttressed piers, by semi-circular arches. The rear wall has a total height above the floor of 40 feet, and consists of two reinforced concrete slabs, the upper half being carried by the roof beams and horizontal beams, the lower half being carried by the reinforced concrete columns which carry the horizontal beams above. These beams are reinforced for both horizontal and vertical bending moments, since they carry the reaction from the pressure of earth on the slab, as well as the weight of the slab itself. There are seven arch ribs, springing from the columns, each 36 inches wide and 24 inches thick at the crown, reinforced with six 1¼-in. square twisted bars. On these arch ribs are carried 12-in. concrete walls supporting the skeleton beams for the prism lights in the roof system. In the front of the bath house, these arches are carried by double piers into the foundations. The buttresses are masked by two spectators' galleries, four feet wide, running the length of the bath house, and over-looking the swimming pool. Access to the roof, and to these galleries, is had from a winding stair laid on the ground at the end of the structure. Another feature of interest is a concrete arch of elliptical outline, connecting the two belvideres at the end of the pool, upon which are two diving blocks and two water chutes. A free, winding stair leads up from the pool to the crown of the arch. There are a total of 750 cu. yds. of mass concrete, 1,350 cu. yds. of reinforced concrete, together with about 90 tons of reinforcing steel, in this structure.

The enclosed areas are heated by steam from a boiler plant of 2,000 sq. ft. radiation capacity, to be housed in a reinforced concrete boiler house adjoining the bath house. Electric light current is supplied from the mains of the National Park Commission; there are about 500 25-watt tungsten lamps for lighting the dressing rooms alone. On account of the large amount of water present at all times, it was necessary to waterproof the entire structure, including the swimming



General plan of pool and bath house.

pool, with a 5-ply felt and pitch membrane, applied throughout by Messrs. J. E. Deegan & Sons, of Calgary. The general contract was carried out by Messrs. Worswick Bros., of Winnipeg, the total cost amounting to upwards of $200,000. The entire design was made and carried out by Mr. W. S. Painter, of Banff. The Superintendent of Construction for the Government was Mr. Stanley W. Coombe.

Locating and Mapping Pipes and Valves on an Old Water Supply*

By Carleton E. Davis†

FOR the adequate control and effective operation of the distribution system of a municipal water-works, the location of pipes and valves should be definitely known, as well as the function performed by such pipes and valves. Data should be recorded in such a way as to be readily understood and interpreted and should be accessible for immediate use, in case of an emergency, by more than one person. The more complex the system, the more important becomes definite and easily-used recorded information, as distinctive from information stored only in the minds of certain individuals.

For one reason or another, too much dependence has been placed upon the personal knowledge of individuals, or perhaps a single employe, and too little has been done upon the work of recording facts and data in such shape as to be of use by any person, incidentally extending thereby the usefulness of many persons. The lack of proper records and plans may be felt in a minor degree as an everyday handicap, but is liable to be particularly emphasized in case of an accident such as a break in a main pipe. Here the flow of water must be stopped, and the circulation readjusted so as to cause as little annoyance and inconvenience to consumers as possible. This means that a number of valves must be first found, and then operated in such a manner as to produce the desired results, and such work must be done quickly.

Of scarcely secondary importance is the necessity of similar records for service pipe connections from the mains in the streets to the properties of the consumers. Affiliated with these latter records is the data recording the arrangement of water piping inside buildings or private properties, with special reference to unauthorized outlets or connections with a private, and possibly contaminated, water supply for fire or manufacturing purposes.

The situation in Philadelphia may be typical. It is not intended in this paper to give the details of the locating and mapping work that is being done in this city, but to briefly outline the general principles controlling such work.

The original water-works of Philadelphia were constructed about 1801. The first cast iron pipe was laid in 1817 and considerable pipe which was in the ground as early as 1820 or 1830 is still doing service in the distribution system. The present city is an amalgamation of a number of distinct municipalities some of which had a water supply at the time of incorporation with the larger community. Such water-works were joined to the Philadelphia supply and are even now a part of the general system.

As the city of Philadelphia has grown, various water supply projects have been developed, used, outgrown, and abandoned in whole or in part. During the last fifteen years the introduction of a filtered water supply has brought about a radical readjustment of the principal supply mains and a re-alignment of the distribution districts.

Certain general maps and plans are available, invaluable as a basis of a more comprehensive and useful record scheme, and representing a large amount of research in the past, hard work, and wise foresight. These particular maps in Philadelphia were compiled by Mr. William Whitby of the Bureau of Water. They are now being developed and expanded with a view of increasing the amount of detailed information, distributing such information widely throughout the Water Bureau, and putting it in such shape that a larger number of employees can be used to a greater advantage by reason of its existence and accessibility.

The scheme provides certain general features:

(1) Data used chiefly for controlling and regulating the amount and pressure of water throughout the system; in other words, data used in operating the supply.

Under this head are maps defining the limits of the several distinct distribution areas, which maps are accompanied by data showing the sources of supply for each area and a list of valves controlling the supply; likewise general maps showing all large mains, reservoirs, and pumping stations, together with detail maps of the piping system and operating valves at the pumping stations, filters and reservoirs.

(2) Data used chiefly for repairs and maintenance. Under this head are detail maps showing the complete gridiron of distribution pipes on which the location of all valves and hydrants are indicated. The detail of such maps is expanded by intersection plans showing on a larger scale the situation at each street intersection. Each street intersection is mapped on a separate plan of a size convenient for use in the field.

(3) Data used chiefly for the business relations between the consumer and the Bureau of Water.

Under this heading come data relating to service pipe connections, such as the location, depth, size, date of insertion, kind of pipe, etc. This data is listed in a card index and filed by streets and numbers.

The system likewise proposes under this head full plans of all pipes in important establishments which may have a special supply for sprinkler systems or other fire protection. These plans will indicate the relations between pipes carrying city water and private pipes which may carry a possible polluted water from a private source, introduced for the purpose of fire protection or manufacturing. The necessity for the complete severance of these dual supplies can be readily seen.

Assuming an available force of sufficient size and individual experience and capacity, the work of mapping pipes and valves proceeds normally along three lines:

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* Presented before Section D of the American Association for the advancement of Science, at the Philadelphia meeting, December 30-31, 1914.

† Chief of the Bureau of Water, City of Philadelphia.

(1) Compilation of existing data wherever and however that data may be listed.

Reports and plans were searched and examined, though of course the chief mine of information was found to be in the memory of old employees. Considerable tact and discriminating judgment were necessary to elicit the information stored in the minds of these old employees and give to such information its true value and assign to it its proper place.

(2) An investigation and determination of the present and possible function and use of the several parts of the system.

In investigating the use and possibilities of the present pipes, pitometer corps equipped with apparatus to readily measure the flow in any pipe, have been used to great advantage.

These pitometer corps served a twofold purpose, for while measuring and studying the flow of water and determining its fluctuation, they at the same time detect leaks and locate points of undue use or waste. Incidental to this study of the flow is the operation of control valves in the course of which the location of the valves is verified, their condition and character noted, and other data obtained which forms a part of the detail location maps.

More or less information is likewise brought to light concerning service pipes, even some unknown ones being unearthed. Various devices are on the market which aid in locating the lost service pipes, though sometimes nothing but digging will bring the desired information.

Governing the rather restricted operations of the pitometer corps, is an overhead study of the whole distribution field, including investigation of proposed changes in the major control system.

Like the pitometer corps, which obtains certain incidental facts while working along definite lines for the purpose of obtaining other information, the general repair and maintenance forces are likewise utilized for the same purpose. Without adding noticeably to their labor, they turn in much that is valuable in the shape of permanent records. Each foreman in charge of a repair or maintenance crew is furnished with a pad of paper showing the lines of typical street intersection with house lines, curb lines, etc., printed on it. Whenever and wherever such a crew is called for work, the foreman is required in his spare minutes, which always occur in such an operation, to list up on these blanks such data as an intelligent inspection of his immediate vicinity will discover. He likewise is required to operate such valves as can be conveniently handled and turn in a record of such operation. These field records are sent in to a central office and are used in verifying permanent records or for making new records on the detailed maps.

(3) The proper recording of new work and the reduction to tangible shape of existing data.

The system in vogue in Philadelphia depends upon the centralized overhead control. All new work is directed from a central office thereby insuring uniform practice and procedure, stimulating branch offices by the feeling that their returns are scrutinized and compared with similar returns from other branch offices. As the attempt is made to secure results from what would otherwise be lost time, or in other words, a utilized by-product, this introduction of competition is valuable. Uniform practice and procedure is essential as a man transferred from one section of the city to another feels at home among the familiar records, even though the geography of the district is strange.

Book records have been discarded as far as possible in favor of records capable of easy and rapid reproduction. A complete and satisfactory record, distributed as widely as desired, may not be obtained for some time to come but enough has already been accomplished to prove the worth of the system.

At the annual meeting of the Dominion Bridge Company, it was reported that 42 per cent. of the steel for the new Quebec Bridge had been fabricated and 18 uer cent. erected. It is anticipated that the work will be finished on time and within the original cost estimates.

There has just been completed on the water front between the terminals of the Brooklyn and Manhattan Bridges in Brooklyn, N.Y., what is said to be one of the tallest steel reinforced-concrete buildings in the world. It covers a plot 200 x 125 ft. It is twelve storeys in height and it is surmounted by a clock tower of four additional storeys. The height from the street level to the roof of the tower is 275 ft.

A municipal refuse-utilization plant is being built at Columbus, Ohio. The saleable refuse will be picked from an inclined conveyor belt and baled. The tailings will be burned in a two-cell Stirling furnace, built by the Griscom & Russell Company, New York City. The cells will have a rated capacity of about 45 tons a day. Steam generated by a 150 h.p. boiler will be utilized at the near-by municipal electric-lighting plant.

Rebuilding the Edison plant at West Orange, N.J., after the destructive fire last month, is proceeding as rapidly as possible. The first step toward rebuilding was the leasing of two complete cement-gun outfits from the Cement Gun Company, of New York City. It is the intention to use these machines in repairing the damaged columns and girders, though the precise methods of repair have not been fully decided upon. Steel window sash with wire-glass are already being installed in some of the burned-out buildings.

Toronto made quite a respectable showing in building construction last year, the permits issued representing an expenditure of nearly $21,000,000. In the detailed classification of the work we find 3,482 brick dwellings, to the value of, roughly, $9,000,000; factories to the value of $1,678,000; schools to the value of $1,667,000; stores to the value of $1,386,000, and warehouses to the value of $1,270,000. These are the items which exceed the $1,000,000 mark.

At the recent Texas State Fair one of the interesting exhibits embraced a monolithic silo 53 ft. high and having a capacity of 15 tons of silage. The silo proper was 43 ft. high and 14 ft. in diameter with walls 6 in. thick. On top of the silo was a water tank having a capacity of 10,000 gal. Inside the silo was a stairway leading to the top so that the entire construction could be inspected. Adjoining the silo was a garage built with Truss-Con metal lath. There was also a concrete storm cellar, concrete benches and other concrete furniture.

Latest Advances in Inoffensive Sewage Disposal*

By Dr. Rudolph Hering†

SEWAGE disposal, since it first appeared as a factor in city sanitation, has in many cases given but scant satisfaction in its executed works, and occasionally even much trouble, until within the last few years it came to be better understood than before. Now, it is not only possible but economically practicable to collect the sewage at its sources, and to carry it to outfalls and there dispose of it, so that nowhere a nuisance results and all danger to health is reduced to a minimum.

It is the purpose of this paper to assemble briefly the principles which govern the subject and the means by which the above results may be accomplished. The nuisance subject will be considered first.

Sewage is dirty water and contains roughly one part of dead organic matter and one part of mineral matter to between one thousand and five thousand parts of water. It is only the organic matter which concerns us here. Some of this is unstable, breaks down quickly and may putrefy within a day, such as certain animal and vegetable liquids, and some is stable and decomposes very slowly, such as hair, wood fiber, epidermis, cartilage and the like. The unstable matter alone eventually causes all the nuisance arising from sewage. It has but a slight resistance to decomposition. It first absorbs oxygen with avidity to form more stable compounds; these have no offensive odor of themselves nor do they produce gases with foul odors. Then, when the conditions have become such that oxygen for absorption is no longer available in the medium holding the unstable matter, other chemical processes become active, producing chiefly hydrogen compounds. Among the latter we have those which produce foul smelling gases and others which do not.

The author, Dr. Hering

In view of these facts, and in order to prevent offensive consequences, the practical engineer is obliged to place the sewage from first to last under conditions that permit of its being collected and carried quickly and completely from the points of origin to those of final disposal, and delivered at the latter points before the available oxygen in the sewage water can be exhausted. He is also obliged to provide means to facilitate decomposition by contact with oxygen, so far as practicable, and in its absence by such combinations of hydrogen as will produce no offensive odors.

All of the processes of sewage decomposition are accomplished chiefly by the presence of certain bacteria which in their activity produce gases, some of which are offensive and some are not. We are here concerned only with those ways and means which will avoid the evolution of offensive gases.

Let us first consider the works for collection and delivery of the sewage with respect to achieving these desired results.

Our wash and bath rooms, toilets, kitchens, laundries, etc., are now supplied with fixtures in such a manner that offensiveness can be entirely excluded. This is done simply by giving them forms and surfaces upon which the dirty water can flow away quickly, no solid particles remain on the surfaces and a final flushing with clean water will restore the receptacles to their condition before use.

The pipes carrying into the sewers the sewage thus generated, should likewise carry it away quickly and completely. The means for accomplishing this are first, smooth and evenly curved and jointed pipes, and secondly, good currents of air circulation. The former prevents catching, retention and consequent putrefaction of solid particles, the latter tends to clean up the exposed surfaces which are otherwise usually covered with slimy growths. This air circulation is automatically established by providing openings to the sewer from the street surfaces, and openings to the house pipes above the roofs of buildings.

It was formerly strongly opposed, particularly in England, to have street sewer air pass up through the house pipes to the roof. It was feared that street sewer air might enter rooms through imperfect pipes or through the fixtures if their traps were not in order. This opposition is still generally maintained. On the European Continent and in many American cities, the ventilation of street sewers through house pipes has, however, been found very advantageous. The house pipes are kept much cleaner, the slimy coating is largely removed and the escaping air above the roofs is less odorous than when the house pipes are trapped at the bottom against the street sewer. A careful examination made in this country proved that the escaping air from house pipes contains practically no disease germs or other bacteria.

After the house sewage enters the street sewers it should be kept flowing without any interruption. This result is readily gotten if the sewers are designed and built with reference to getting it. The surfaces again should be smooth. Vitrified clay pipes, used for small sewers more than any other kind in this country, have the smoothest surfaces. Yet the inevitable projections at the joints, due to the manufacture of the pipes, reduce this advantage to some extent. In practice, therefore, the pipes are laid so that there is no projection at the bottom, upon which the sewage flows and which would retain solid matter, but that all of the projections are at the top. Cement pipes can be made almost as smooth as vitrified pipe and have no projection at the joints. Concrete sewers have the same latter characteristics. Brick sewers furnish the roughest surface, even if the joints are carefully made and the bricks are of the best. With good flushing and brushing down at proper intervals even brick sewers may be kept in a condition so as entirely to prevent offensive odors from generating therein.

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Sewer Functions

Other important elements as regards odor production are the junctions of several sewers. They must always be made so that the sections above them are gradually and not suddenly merged into the sections below them, which construction prevents eddies and deposits resulting in putrefaction and odors.

Finally, to preserve an inoffensive condition in sewers we must establish within them a systematic ventilation and flushing.

Ventilation is generally secured by the natural differences of temperature existing in various parts of the sewer system. It has been found best to let the air circulation take care of itself, by providing the necessary openings, ample in size, for the air to enter and others for it to escape. It happens sometimes on cold days that the air circulation is in the opposite direction to that on hot days. This reversal of current is not objectionable if the sewers have no foul deposits in them and if the ventilation has at all times been free and ample. Artificial ventilation was thought necessary in former times and numerous contrivances were introduced. Today, after long experience, it is known when sewers are properly designed and built, and properly cleaned and flushed, that natural ventilation is entirely sufficient and satisfactory.

Importance of Flushing

Flushing is another important requirement for the sewers to prevent offensive odors in them. Above ground, within our houses and on our bodies, we use ample amounts of water for cleansing purposes. Below ground in sewers, ample flushing is equally and even more necessary, due to the relatively greater concentration of unstable decomposing organic matter. Unfortunately in our country the finishing of sewers has not been given as much attention as is desirable. In almost all European countries, both small and large sewers are flushed frequently, varying from several times a week to once in one or two months. The results of this frequent flushing are very satisfactory and the money is willingly appropriated.

In our country, particularly in smaller cities, we have extensively introduced automatic flush tanks at the heads of all pipe sewers. While these tanks keep the upper ends of the sewers clean and free from deposit in a very satisfactory manner, they do not keep the larger sewers lower down the line free from deposits and odors. In this respect our sewer systems could be greatly improved and the odors therefrom materially diminished.

When collecting sewers are very long and the distance to the outfall isgreat, which fact is generally associated with flat grades and slow velocities, we have almost always some putrefaction and offensive odors arising near the lower end. During the long run the oxygen has become exhausted and hydrogen compounds, notably sulphuretted hydrogen, are developed The obviation of this condition may be secured by emphasizing several remedies above mentioned. For instance, the surface of the sewer should be made especially smooth, means might be employed for a more thorough flushing than would otherwise be necessary and the grades and sewage velocities might be improved by the introduction of a low lift or booster pumping plant.

Still another expedient might be practicable, by replenishing through artificial aeration, the dissolved air, from which the oxygen has been exhausted and putrefaction has been initiated. Experiments have been made recently both in England and in America to accomplish this purpose and have resulted in more or less success. Where it is possible to force air into a sewage pumping main, under a pressure of at least one atmosphere, good results have been obtained with the sewage after its discharge into a sewer. Distributing air into the sewage within the flowing section and under ordinary pressures seems as yet to have given only moderately good results.

There is one more means by which the fouling of sewage on a long run can be reduced and incidentally also the expense of the final sewage treatment. When we consider that but very little of the organic matter which is discharged into sewers at the house, is dissolved, and that about one-half of it is dissolved when the sewage reaches the outfall of an average city, and also, that dissolved matter withdraws oxygen from the water more quickly than the solid matter, we must conclude that a removal of solid matter by fine screening or short time deposition higher up the sewer before much is dissolved, would be of benefit. A number of smaller settling tanks near the beginning of the main sewers might, for instance, not only prevent foul odors near the lower districts, but prevent also the necessity and expense of works for oxidizing the amount of dissolved organic matter which is thus eliminated.

We have now reached the outfall and therewith the point of sewage disposal. Greater nuisances have been caused by improper sewage disposal, than in the collecting system, and yet the ways of avoiding them do not differ much in expense or attention.

It was stated at the outset that we must place the sewage under conditions so that its decomposition will be facilitated by contact with oxygen, and in the absence of oxygen by such combinations of hydrogen as will produce no offensive odors.

All processes of sewage treatment and disposal, if they are to be satisfactory, permanent and economical, should require a separation from each other of the floating matter, of the settling matter and of the liquids.

As these three parts of the sewage are materially different substances, one being solid and light, one solid and heavy and one liquid, the methods of economical treatment in order to make them inoffensive will also be different in nearly all cases and therefore a separation is generally to be recommended. As yet it is not always made, and at some places it may not yet be of sufficient importance to justify the additional expenditure. The drift of opinion ,however, is clearly in the direction of separation and we should endeavor to design our works accordingly.

The floating matter can be retained with little trouble and expense, either by screens or as seen in settling tanks. Being often offensive the best disposition is usually by fire or by burial. Numerous screen designs are now in use, but there is practically no preference so far as the prevention of odors is concerned.

Treatment of Sludge

The settling matter which forms the so-called sludge is that part of the sewage which has always given the greatest amount of trouble. It has constituted the greatest nuisance and, until within only a few years ago, has successfully defied a treatment which would allow of its inoffensive disposal.

The bulk of the sludge does not decompose by oxidation. Its exposure to the air allows but a thin film to oxidize at the surface, but the exposure permits it to take up many species of bacteria, some of which cause inoffensive putrefaction. Many ways and means have been tried for the last fifty years, both in England and Germany, to get inoffensive sludge decomposition. A solution has at last been found in an expedient which allows the sludge to decompose under water with the practical exclusion of fresh sewage and air.

The first step towards getting this result was taken by Dr. W. O. Travis, of Hampton, England, who devised a two-storey tank, the upper division serving as a settling tank with a slot at the lower edge of an inclined bottom, through which the settling suspended matter passed into the lower division to accumulate and decompose. The in- and out-flows of the two tanks were so proportioned that from three-fifths to four-fifths of the sewage passed through the upper division and one-fifth to two-fifths through the lower one. So far as an inoffensive sludge decomposition is concerned, this Hampton tank is not a success.

The same two-storey tank was later built in the Emscher district of Germany by Dr. Ing. K. Imhoff, with at least one important change. No sewage whatever was allowed to pass through the lower tank, causing a practical prevention of any part of the sludge from a continuous contact with fresh sewage and air. Also other advantageous changes were suggested.

The decomposition of the sludge takes place in the lower division of the tank in the absence of dissolved oxygen in the sludge, but the novel condition is that it continues in the absence also of sulphur bacteria, producing sulphuretted hydrogen, and in the presence of bacteria producing substantially only methane and carbon dioxide gases, both of which have no offensive odor. The conditions in the tank gradually become adjusted to conditions favoring the life of substantially only those two classes of bacteria and causing practically all of the others to perish.

The Royal Institute for Water Hygiene in Berlin, through Prof. Dr. K. Thumm and Prof. Dr. C. Reichle, has recently issued a report on the results of a thorough investigation on this new method of inoffensive sludge treatment, from which substantially the following conclusions are extracted:

The process of decomposition of sludge is found to differ sometimes quite materially according to the character of the sewage. The same arrangements and designs will, therefore, not suit all of the conditions nor all localities. The topographical conditions especially as to available areas and elevations make different designs a necessity for economical reasons. They will determine whether the sludge decomposing chamber should be located below (Emscher tank) or beside the settling tank. In all cases a sharp distinction must be made between a simple settling of the suspended matter and the decomposition of the sludge.

In the process of ripening, the sludge of the Emscher tank has a grayish color. When ripe it is deep black, has a peculiar tar-like though not disagreeable odor, and easily allows its water to drain away in a fairly clear colorless condition and without a putrid odor. The sludge reacts alkaline. When left too long in the sludge chamber and when it has become overripe, it again changes to a grayish color and has an offensive odor; it does not easily drain its water and has a distinct acid reaction. In order to decompose quickly and satisfactorily sludge should not be acid. If found to be so, it is generally due to an excessive vegetable diet. It should then be brought into intimate contact with a sufficient amount of slightly acid-neutralizing bodies, among which the most common are fresh sewage and hard water.

The Berlin Experiment Station has pointed out the great desirability of having a proper mixture of sludge and sewage in order to secure a good alkaline sludge. It is, therefore, advised for this purpose to install a mechanical agitator in the tank to be used daily for effecting a thorough mixture. The results of this agitation were always found to be good. The introduction at the bottom of compressed air escaping and rising through the sludge was also found to be effective though less so than mechanical agitation.

It was also found essential to withdraw the decomposed sludge regularly, frequently and in small amounts. If not so withdrawn and at the proper time, it is apt to become acid and dead.

It sometimes occurs that on the surface of the tank there is an undue frothing and excessive scum formation. After due consideration and experiment it was found that these objectionable conditions could be removed by draining off the sewage in the sludge chamber and refilling the same with clean water from the municipal supply, especially if it had considerable temporary hardness. In some cases a good sludge can be produced only by the addition of slight quantities of alkaline, as lime or soda, into the sewage.

The Berlin Experiment Station gave a careful study to the scum and frothing in the settling tank and in the chimneys connected with the sludge chamber; other important conclusions being as follows:

It is not advocated as a permanent measure to reduce the scum cover in thickness by merely an occasional stirring with poles or by breaking it up with a stream of water. It is preferred to use a permanent mechanical apparatus or agitator which not only stirs the scum but brings about a thorough mixture of it with the sewage, subsequently allowing the necessary time for sedimentation. Frothing is found to be due mostly to large amounts of gas rising to the surface from the sludge chamber and carrying up finely divided sludge with the bubbles. Agitation usually prevents this trouble. When the sludge in the lower chamber is ripe, the scum formation in the upper chamber is light.

When there is great activity in the decomposition, sludge particles rise through the slot into the upper chamber in spite of the usual overlapping of one side of the slot, intended to prevent such rising. Sufficient room should be provided for accommodating the floating sludge in order to prevent operating difficulties.

Studies were made of the effects of the relative advantages of two groups of tanks, one having the sludge chamber below and the other beside the settling chamber.

The first group has the great advantage of an automatic sludge separation. It has the disadvantage frequently of increased expense due to the greater depth of excavation. This greater depth has in itself the advantage of placing the gases of decomposition in the lower tank under increased pressure, which causes the sludge to expand, become more porous and more readily drained when it is withdrawn and discharged on the surface of the ground. Another disadvantage of the first group is the necessity of giving a very close attention to the sludge removal, and to get the right proportion of capacity between the upper and lower chambers. Unless the proportion of sludge to the superimposed liquid approximately corresponds to the character of the sewage and sludge, the results may not be satisfactory in finally turning out economically an inoffensive sludge. Expert supervision is required, particularly during the period of ripening.

The second group has the disadvantage of pumping or of conveying the sludge from the settling to the sludge decomposing tank. It has also the disadvantage of producing less easily drainable sludge, due to the shallowness of the tanks. It has the advantage of a complete separation of the two tanks, so that the sludge decomposing tank can never through irregularities have a detrimental influence on the settling tank. Extensions can also be more easily made to the tanks and they can be more readily inspected.

The separate sludge decomposing tanks can be built as single units which are intermittently filled or they can be built as a series of tanks continuously operated.

The city of Baltimore has installed separate sludge decomposition tanks and the experience there gained will be valuable. The city of Brooklyn is conducting some experiments on a similar device of using tanks beside each other and also one over the other. The decomposed sludge is found to be equally good in both cases. The preference between the two methods may usually be decided on the relative economy and facilities for construction and operation.

Disposal of Liquids

Considering now the last part of the sewage to be disposed of, namely, the liquids, we find that the commonest, because cheapest, way of disposal is to turn it into running water. This process is called the dilution method.

There has been much popular objection to such a disposal, partly due to cases that have caused much offense and partly due to sentiment. Neither reason is valid against the method if it is properly applied.

Most of the objectionable organic waste matter on the surface of the earth, is by nature discharged into and purified by either air or water. Our exhalation and all gaseous waste products are purified by a preliminary dilution in the air. All the rain water flowing over the surface of the earth, the accumulated wastes of animal and vegetable life, are washed into rivers and then into the ocean. Some rivers purify such waste matters within a few miles of flow. Some cannot purify at all water loaded with suspended mineral matter. As soon, however, as the ocean or a large lake is reached all objectionable waters are completely purified.

The dilution method is quite efficient for sewage disposal and is in every way satisfactory, provided we recognize the principles on which it can be carried out. There is a certain varying amount of oxygen dissolved in all running fresh and salt water, which is taken up from the overlying atmosphere in accordance with well established physical laws. On the other hand, there is a certain varying amount of oxygen required by the different parts of the organic matter of sewage which is necessary to oxidize it. Therefore, generally speaking, we have the question as to how much of this oxidizable organic matter can be decomposed by the available dissolved oxygen in the water.

A large number of chemical, biological and physical examinations have been made to determine the elements of this problem. A large number also of actual cases of sewage disposal by dilution for American and Europena cities, have given practical demonstrations of the advantages and limits of this method of disposal. The conclusions which may now be drawn from all the evidence are quite satisfactory.

In order to discharge sewage safely into running water so as not to create nuisance, we should first deprive it so far as practicable of all floating matter which would deface the surface of the stream, and of all heavier matter which would settle and deposit on the bed of the stream. The remaining liquids should be discharged so far below the surface as practicable and dispersed into and distributed through a body of flowing water which is great enough to contain the necessary oxygen required to oxidize the organic matter coming in contact with it. A sufficient dilution causes an immediate cessation of all nuisance, if one existed, and prevents its occurrence, if the above simple conditions are maintained. By following such a practice no offense to sight or smell can ever arise.

Another method of oxidizing the liquid sewage is to expose it in such a way that atmospheric oxygen will cause the oxidation of the dissolved organic matter. This is done by the well-known methods of so-called filtration.

The liquids are made to pass through a bed of sand or broken stone, so that the surfaces of the grains become wetted by the percolating sewage. The surfaces in a ripe filter are covered with a gelatinous film, supporting myriads of bacteria which decompose the dissolved organic matter contained in the liquid percolating over the film. The decomposition takes place in the presence at the film of a sufficient quantity of oxygen containing air and of a suitable temperature for the best bacterial activity. There is a definite relation between these factors, and it will be possible, eventually, to so arrange them that the greatest bacterial activity can be determined at the least cost for each given case. This branch of the science of sewage purification yet needs some further development to determine in all cases the best proportions.

If sand is used, the liquids may be turned upon the top of the filter bed, from which they will percolate and wet the surfaces of all the grains and issue in an oxidized condition at the bottom drains. If broken stone is used the liquids must be sprinkled over the surface of the beds, or left in contact with the entire body for a sufficiently long time, generally by repeated applications, to get the same effect.

The recent advances made in oxidizing liquid sewage have not been great. A large field is still open for investigation, in order to obtain the greatest possible efficiency with the least cost under the usually variable conditions of practice.

Removing Menaces to Health

Having now, as regards sewage disposal, covered the subject of nuisance, it remains, in closing, to mention the removal of dangers to health relating to such disposals. These dangers lie in the transportation to other points of pathogenic bacteria contained in the fresh sewage from sick persons and in the subsequent possibility of their once more getting into the bodies of human beings and higher animals.

Bacteria not only adhere to particles of solid matter but remain in any liquid carrying them. It is possible that solid particles of sewage may be stranded in sewers, be held back and finally be blown away by an air current, enter the atmosphere and thus, by contact, cause a new infection. It is also possible that liquids may splash and throw bacteria into the air. In both cases the danger of transmitting disease is extremely small, if the sewers have smooth interior surfaces, no opportunities for eddies to form, and good grades to cause a rapid velocity from the sewage receptacles to the outfall, conditions which have been advocated for many years.

If the sewage is discharged into a sufficiently large diluting current of water, the pathogenic bacteria are gradually starved and perish. If the sewage is treated on land, there is some slight risk of transfer by violent winds. Generally the bacteria are either retained in and carried away by effluent water or are held back on the grains of the filter. In the latter case they eventually perish by exposure in the unfavorable environment, and in the former they can be at once destroyed by an inexpensive chlorin treatment such as is now for the same purpose given to most of our surface water supplies.

From what has been said above I believe that we have at last reached a stage of development in this branch of sanitary engineering which enables us efficiently and economically to collect sewage at its sources, carry it to the outfalls and there dispose of it either in water or on land without causing offense at any point along its course, and with all danger to health reduced to a minimum.

Excavating and Backfilling Sewer Trenches by Machine

Detailed Costs and Explanation of Method Used in Narrow Lanes and Business Streets in Vancouver, B. C.

NECESSITY for employing some advanced method of laying sewers in Vancouver, B.C., was first recognized several years ago when work in narrow lanes and busy streets was seriously hampered by lack of room for spoil banks. After considering several methods, a trenching machine was purchased, which has, after some slight changes to adapt it to conditions, been in continuous service for about three years. Although this machine is not considered economical for shallow trenches or for work in sparsely settled districts, the city has had sufficient sewer construction under way to keep the machine employed continually on work where the conditions were favorable to the best results.

Operation of the Machine

The machine is designed to be set up over a 340-ft. length of trench, from which excavated material is loaded directly into buckets, which elevate it, run back along the trench and dump it as backfill over pipe already in place. It is obvious that the pipe must be laid at the same rate as the excavation advances. The buckets are operated by cables running through carriers on an overhead rail, which is supported over the centre line of the trench and 12 ft. above the surface of the ground by nineteen wooden trestles. Each trestle is mounted on two wheels, one on either side of the trench, which rest on the rails of an 8-ft. gauge track. This track carries the engine as well as the entire 340-ft. length of frame-work, thus greatly facilitating moving ahead as work advances.

Excavation is carried on simultaneously in two 48-ft. lengths of the trench, a gang of six men working in each. The machine is equipped for handling six 1/5-cu. yd. buckets at a time, so that by keeping eighteen buckets on the job a set of empties is always left in the trench when full ones are removed, and the workmen need never wait while buckets are being dumped. Under this plan each man has an 8-ft. length of trench to work in, and fills his bucket independently of others. When loaded buckets are hoisted to the limiting position they are automatically locked to the carriers, which are then drawn along the overhead rail to the point where the fill is being made. Here the buckets are dumped separately by a lockman, who moves along the bucket line on a plank walk supported by the trestles. This lockman signals the engineer for each move, and is the only man required on the bucket line, the empty buckets being taken from the cables and full ones substituted by the workmen in the trench bottom. The work of taking down the machine, moving to another job and setting up again ordinarily requires three to four days' time with a crew of ten men. Thus with a haul of, say, 1 mile, the total cost of removing from one setup to another is about $170.

Canvas Troughs

When small trunk or lateral sewers were uncovered for any considerable length in excavating the trench temporary provision was formerly made by carrying the flow during construction in open wooden troughs fixed to the side of the trench. It was found, however, that, besides being expensive to handle and move, these flumes interfered with the work and caused frequent trouble which could be entirely eliminated by the use of closed canvas troughs. The latter were made by simply affixing eyelets to opposite edges of a strip of heavy canvas of any desired width up to 3 ft. Eyelets on both edges of the strip are then hung on the same set of spikes driven into the timbering on the side of the trench and placed, roughly, on a fairly steep grade. This type of trough is often strung for the full 340-ft. length of the trench, and the laterals encountered are connected to it by short lengths of similar tubing.

Timbering Methods

A considerable quantity of timbering is taken from job to job with the machine, breakage being replaced as required. It has been found, however, that with the system now in use the breakage is almost negligible. For all classes of soft material 1½ x 10-in. sheeting is used in 4-ft. lengths, and it has been found that this works to much better advantage than the longer sheeting, which would require driving. When the trench has reached a depth slightly over 4 ft. digging is stopped while the timbering is placed.

The diggers all help in placing the timbering, at least until the stringers are braced in by jacks, after which excavation is resumed, while the man detailed to look after the timbering sets the struts and lines up the timbers generally. This man spends all his time attending the timbering—carries it forward as fast as it is removed from the backfill and lays it along the trench where it will be needed in new excavation. Thus, when a new set of timbering is required, all material is ready to be passed down by the timberman, and as the workmen do not have to leave the trench, the entire operation of placing timbering in a 48-ft. section 4 ft. deep delays the work only about twenty minutes. One 3 x 12-in. stringer is placed midway of each sheeting set, and opposite stringers are braced by 4 x 4-in. struts, spaced on 8-ft. centers. When nearing the depth at which sheeting will no longer be required the sheeting is changed from 1½-in. to 1-in. material, which still further reduces initial cost and cost of handling.

Exclusive of supervision, seventeen men operate the machine. These include twelve pick-and- shovel men filling buckets in the trench, one lockman, one engineer, one timberman, one toolman and a straw boss. Only half of the superintendent's time is charged against the machine, as he ordinarily looks after two jobs. In addition to the machine crew, a gang of four men is used in laying sewer pipe. Whenever the pipe crew gets behind with its work some of the diggers are set to helping with the pipe or concrete; and, vice versa, when the pipe crew has extra time it is used in the trench ahead. Thus it is possible to equalize any deficiency in forces or to compensate for unforseen difficulties in either branch of the work, a flexibility which is considered a great aid to efficiency.

In order to give a fair idea of actual capacity of the machine and the cost of operation, a typical case has been selected in which about 7,700 cu. yd. were handled in a 2,700-ft. trench excavated for a 2-ft. trunk sewer. This work was done in Granville Lane, Vancouver, which has a width of 20 ft. A start was made on the lower end of the trench, hand labor being used until a depth of about 8 ft. had been attained. The machine was then put in service and used until the job was finished. The maximum depth of the trench was about 26 ft. The trench has a top width of 4 ft., which was maintained until a depth of 12 ft. 6 in. was reached, below which no timbering was used, and the width gradually decreased to 3 ft. at the bottom. The work was begun in the fall of 1913 and continued without interruption, using one eight-hour shift. The average volume of excavation handled in eight hours was 45 cu. yd. A careful distribution of the costs on this work gives the results shown in the table.

Costs of Excavation on Granville Lane

	Cost per cu. yd.
Labor (including superintendent and watchman)….	$1.63
Hauling machine to the job (total $88) … … …	.0115
Erecting and taking down machine (total, $96) …	.0125
Upkeep of plant … … … … … … … … ..	.0428
Running expenses … … … … … … … …	.1126
	$1.81
Depreciation of plant . . … … … … .. …	0.04
Interest on cost of machine at 5 per cent. … …	.02
Total … … … … … … … … … … ..	$1.86

The last two items in the table are values assumed for the city of Vancouver, and might be quite different under other circumstances. The life of the machine was assumed at ten years, it being assumed that in city service it would last much longer than in ordinary contracting service, and 5 per cent. is the rate at which the city secures money for such purchases. It should be noted that only one haulage charge is made in these figures. This is because the machine is kept busy continually by being moved from one job direct to another. In contractors' service, if the machine were returned to the storage yard after each job, the haulage item would be doubled. The labor item, which is so large a proportion of the total, is based on the following unit labor costs per hour for an eight-hour day: Pick-and-shovel men, 40 cents; timberman, 42½ cents; lockman, 42½ cents; steam engineer, 53⅛ cents; toolman, 37½ cents; straw boss, 42½ cents, and one-half superintendent's time, 62½ cents. "Upkeep of plant" includes ordinary wear and tear, as well as minor breakage, while "running expenses" includes coal, oil, water, timber, tool sharpening, etc. Two items which might have to be included under other circumstances are employer's liability insurance and excess spoil haulage—the latter in cases where excavation and fill could not be figured to balance.

The question of minimum trench depth at which the machine would be efficient has been worked out for Vancouver labor price as about 8 ft. for the usual case. However, if the job was comparatively short and the haul very long, a depth as great as 12 or 14 ft. might be the minimum. A feature that tends to make pick-and-shovel men efficient, or at least keep them all up to a uniform standard, is the fact that no one can do less than the others without having this known, since all six buckets come up at once; when one man is slower than the others he will still be working while the remainder of the crew wait. It is to be noted that in practice this generally works out so that after the first few days on a job there is remarkable uniformity in the time the men require for filling buckets.

The machine used in Vancouver was purchased early in 1911 for $5,000, duty paid, and was made by the Carson Trench Machine Company, of Boston, Mass. F. L. Fellowes is city engineer of Vancouver, and all sewer work is done under the supervision of A. G. Dalzell, assistant city engineer.—Engineering Record.

Sewer Tunnel Construction

A sanitary sewer district of 13½ miles of main sewer consisting of 8, 10, 12, 15 and 16-inch pipe and 4½ miles of 6-inch lateral connections built by Chas. E. VanWromer, of Springfield, Ill., contractor, has been completed and accepted by the Board of Local Improvements of Alton, Ill., and is now in successful operation. Details of construction, which may be found interesting in their application to Canadian municipal work are contributed to Municipal Engineering by Mr. J. E. Schwab, City Engineer of Alton.

In the construction of the system it was necessary to construct an outlet sewer two miles in length to the Mississippi River about, 1,000 feet of which is in tunnel through a hill 39 feet high, in which 12-in. cast iron pipe was laid at proper grade. The contractor in the construction of this tunnel deemed it a small job in itself and thought it not advisable to provide an expensive equipment for the construction of same.

Such difficulties as arose during the construction had to be met with a rough equipment on hand.

The stakes were set every 50 feet on the centre line and every 200 feet shafts were sunk to the proper grade. These shafts were made 4 by 8 feet and properly braced with oak timbers. The 8-foot side was parallel to the centre line of the sewer. At each side of the shafts plumb-bobs were dropped and used to line up the tunnel driving.

Two shafts were worked at a time. Over each shaft was placed a swinging boom from which a wooden bucket was lowered and raised in the shaft with wire rope. Midway between the shafts an ordinary double-drum hoisting engine was placed. The wire rope from the buckets wound on these drums so that when one bucket was up the other bucket was down in the shaft. At the bottom of the shafts the heading was driven in both sides at the same time. The tunnel was made 6 feet high and 3 feet wide. The sides and top were sheated with 3-inch oak planking as the tunnel was driven. One man was at the heading, one man loaded the wheelbarrow and wheeled the muck to the shaft, where it was dumped into the buckets and raised to the surface and dumped. When a tunnel had been driven half way to the next shaft, work from that end stopped, and the men went ahead to the next shaft. The heading men usually met very close to the centre.

One difficulty experienced, was lack of ventilation. It was impossible to keep a light burning in the tunnel so that men could see or breathe after they had gone a few feet from the shaft. To overcome this an ordinary blower fan was secured and a 1½-h.p. gasoline engine was used to operate same. From the discharge end over the blower fan a 3-inch galvanized iron down-spouting was connected by means of tees, elbows and straight pipe down into the two shafts and thence each way into the headings. This fan furnished sufficient air so that all four headings could be worked continuously.

The booms above the shafts were also used for lowering the 12-inch cast-iron pipe. The pipes were lowered at the lower shaft and pulled ahead by cable tied to hoisting engine. When all the pipe had been lowered to extend from one shaft to the other and pipes were lined up and set to proper grade, spigot ends were driven home into the bell ends and yarned and calked with lead. The entire equipment was then moved to the next shaft, and the same process as above described was gone through.

The entire 1,000 feet was driven in this way. Three shifts were steadily employed, each working 8 hours. The total cost of the improvement was $97,000.

The tunnel was driven and pipe laid in eight weeks. The work was carried on under the supervision of the writer as city engineer.

A recent investigation by the New York State College of Forestry in co-operation with the United States Forest Service of the wood-using industries of the state has decided the fact that enormous quantities of larger sizes of lumber are now being manufactured into small articles, when they might profitably be made from slabs and other material formerly wasted. Wood is becoming of such value and the forests are being so rapidly depleted that new uses must be found for these materials. For instance, sawdust is now becoming of sufficient value to ship it to points where it can be used for ice packing, stable bedding, stuffing for upholstery, packing glassware and for the shipment of metals and crockery. In Europe sawdust is compressed into briquettes and sold for fuel.

"Le Genie Civil," one of the leading French technical papers, announces that so many members of its staff are at the front that it will be necessary to issue the paper bi-monthly instead of weekly as heretofore.

Remedying and Preventing the Dusting of Concrete Floors

WHY is it that in two concrete buildings apparently constructed under identical conditions, built by contractors of equal intelligence and integrity, from concrete composed of similar aggregates and the same brand of Portland cement, the floors in one will turn hard, firm and resistant to abrasion, while in the other ordinary usage will result in dusting sufficient to make necessary some remedial measures?

The fact that numerous dustless concrete floors have been laid seems to indicate that the trouble must lie in the selection, proportioning, mixing, placing or finishing of the material. The procedure and proportions described below have given excellent results, though undoubtedly different mixes have also been used with satisfaction.

Special precautions should be taken to insure first-class work. A rich mixture is desirable, say, a 1:1:1 mix, in which the aggregate consists of granite, or other hard stone, screenings graded from ¼ in. in size down to the finest, and crushed stone of equal quality passing a ½-in. ring and retained on a screen having ¼-in. mesh. All trowelling and finishing of the floor surface should be completed within 2½ hours from the time the materials leave the mixer. This necessitates mixing the material for the wearing course to such consistency that the mortar has to be scraped from the wheelbarrows and will hardly flatten out when dumped upon the floor, yet wet enough so that it can be "struck off" with little difficulty when spread out with shovels. The floor usually is in a condition to be trowelled for the last time within an hour and a half or two hours after the wearing course has been mixed. When sufficiently hardened to prevent pitting the floor should be sprinkled with water until 2 in. of sawdust can be thrown on the surface without injury. The sawdust should be thoroughly wet down and kept moist by sprinkling for a period of two weeks.

Numerous experiments in curing concrete have demonstrated conclusively the superior quality of specimens which are properly cured by being kept moist for a period of two weeks or more. Wetting is quite common with other types of concrete work and can be relied upon to give as satisfactory results with floors.

There are so-called hardeners on the market intended to be used with the finishing coat. In using these preparations careful supervision of the work from the time the concrete is mixed to the time that traffic is allowed on the floor is made a prime requisite for success. In all probability if the same care and attention are given to the workmanship and curing of floors in which no integral preparation is used, an excellent surface will result.—Engineering Record.

Looking to the extension of Canadian trade, it is interesting to report that the Boards of Trade of Victoria and Vancouver are co-operating in an endeavor to secure the appointment of a Commissioner for South America to represent British Columbia in that country.

Steel Structural Engineering—Some Phases of Its Past, Present and Future

(Conclusion)

ERECTION standards have been greatly raised through the previously mentioned improved shop processes, the use of electric power in the conduct and control of field operations, the development of modern tools, especially the pneumatic hammer, and the use of tapered rivets to ensure efficient upsetting. It has been demonstrated that 1¼-in. field rivets in the Hell Gate Arch, with a 9⅞-in. grip, and the 1⅛-in. rivets of nearly the same length in the Quebec Bridge, can thus be easily driven to fit for their entire length.

The scale which modern erection operations have attained may perhaps be set forth most impressively by the statement that the steel falseworks of the Quebec Bridge weigh 3,000 tons and that the two 225-ft.-high steel travellers weigh nearly 1,000 tons each, not to mention the material used in the 90-ton girder crane and the 495-ft. runways in the field storage yard.

Notable Bridges Under Construction and Projected

The fabrication of this bridge in the mammoth shop built primarily for that purpose is progressing rapidly. Of the total weight of steel—65,000 tons—about one-third has been fabricated and about 10,000 tons erected, one of the anchor arms being nearly completed. A world record was established about a month ago with the erection of 410 tons of steel in a single working day, including the driving of 16 large pins. No better evidence than this marvellous record could be adduced of the extreme care that had previously been bestowed upon every detail.

To engineers, the circumstances that the Quebec Bridge, with its channel span of 1,800 ft. between pier centres, will be the largest bridge in the world, is wholly secondary in interest to the many striking innovations in design, fabrication and erection to which it has given rise. Space precludes more than brief reference to a few of its principal features. First in importance is the straight-cord, K-truss design, involving a type of truss heretofore practically unknown in this country. Its advantages for long-span bridges have become so evident that their possible disregard by future designers under similar conditions will have to be professionally justified on more substantial ground than the mere striving for seeming originality. The K-truss is statically determinate, comparatively free from secondary stresses, admirably adapted to erection, and ensures the distribution of the shear in each panel between two principal web members, with obvious incidental advantages in other directions. To engineers the conception of this truss should be as welcome as it was unexpected. Its striking originality is deserving of the most generous professional recognition.

Among the details of this bridge perhaps the most noteworthy features are the admirable design of the truss members, the use of separate pins for individual members, the omission of the upper lateral system, the cradling, in lattice box-trusses, of the long top-chord eye-bars,—not only for their own support and for the lateral transmission of panel wind loading, but incidentally and in no unimportant degree for appearance,—the suspension of the transverse floorbeams in the central plane of the main trusses (which are in a certain sense double trusses), the use of pin bushings for greater flexibility at certain joints, the adoption of 100 per cent. chord splices throughout, and of special trusses for the transmission of tractive forces.

In referring to so huge a structure, one readily yields to the temptation of citing especially significant figures. The main pedestals weigh 500 tons each; the 9 x 10-ft. main posts above the piers are 310 ft. long, have a cross-sectional area of 1,903 sq. in. and weigh 1,500 tons each; the largest (7 ft. 2 in. x 10 ft. 4 in.) lower-chord member has a length of about 85 ft., a cross-sectional area of 1,902 sq. in. and a weight of about 420 tons, though it will be erected and assembled in four parts; the largest pin is 30 in. in diameter, with 45-in. bushings, and weighs about 6 tons.

According to schedule the Quebec Bridge will be completed in 1917.

The erection of the Hell-Gate Arch, designed by Gustav Lindenthal, will be begun next April and finished in about four months. On the Long Island side the temporary anchors for erection the arch cantilever-fashion are nearly completed and preparations for their installation on the Ward's Island side are in progress. With its span of 977.5 ft. between centres of end hinges this arch will be the largest structure of its type in the world. Apart from the extraordinary boldness and originality of the general design, this bridge contains many new features of unusual interest, notably the rocker joints at the chord splices designed to minimize eccentricity of chord stress, the cantilever arrangement of the lower laterals, and the braking girders for the transmission of tractive forces.

The total weight of steel in the arch proper is 20,000 tons, the heaviest bottom chord section having a shipping weight of 150 tons. The cross-sectional area of this member is 1,385 sq. in., but it is necessary to ship it in longitudinal halves.

The entire completion of the bridge with its long approaches is expected by the end of 1916.

Sciotoville Bridge

This bridge, also designed by Gustav Lindenthal, will cross the Ohio River on the line of the Cheaspeake & Ohio Northern Railway. It is a proposed double-track structure, about 3,500 ft. long, with two 775-ft. channel spans.

The design marks a radical departure from current practice in that the main trusses will be constructed as all-riveted continuous girders over three supports. Taking advantage of the rock foundations at the site, the designer will thus effect an estimated saving of about four million pounds of steel, in comparison with an alternative plan involving the use of two independent spans. The contract for the masonry for this bridge has been let and work on the foundations is in progress. The detailed plans of the superstructure have been completed, but the award of the contract is in abeyance.

Other Large Bridges

Other large bridges for which the contracts for the steel superstructure have been let are the Memphis Cantilever Bridge across the Mississippi River, designed by Ralph Modjeski, which, with a maximum span of about 790 ft., will supplement the present structure in the immediate vicinity; and the Metropolis Bridge across the Ohio, designed by C. H. Cartlidge, in which the longest simple span has a length of about 723 ft. between pier centres.

Important Bridge Projects

The delay or indefinite postponement of large bridge projects will doubtless be among the many consequences of the European War. Under present conditions the consummation of such mammoth projects as the 2,880-ft. North River Trussed-Cable Suspension Bridge, and the proposed San Francisco Bay Cantilever Bridge, with three 2,000-ft. spans, seem sufficiently remote. Other long-discussed and recently revived projects are those for a 1,071-ft. cantilever bridge across the Mississippi at New Orleans, and a 1,600-ft. cantilever bridge across the mouth of Sydney Harbor, Australia. The live load for the latter is 15,000 lb. per foot of bridge, or nearly 50 per cent. higher than for the Quebec Bridge. The life of its steelwork is estimated at one hundred years, or safely in excess of the prospective life of the estimator. Between two alternative designs, the one for a K-truss, the other for a sub-triangular truss, the Parliamentary Public Works Commission has recommended the latter.

Reconstruction and Reinforcement

Broadly speaking, every important bridge built 25 or more years ago has been either reinforced or displaced on account of increased loading. The plans for increasing the capacity of the Queensboro Bridge by rearranging the tracks will necessitate reinforcement and other changes in the floor-system, at an estimated cost of over three million dollars, although this bridge has been in service for scarcely more than a single decade. The plans for reconstructing the previously reinforced Brooklyn Bridge involve the entire replacement of the suspended structure.

The recently completed reinforcement of the Williamsburgh Bridge had as its crowning feature a cleverly contrived bit of bridge surgery in a midnight operation involving the replacement of four 10-in. carbon-steel pins by 13-in. pins of nickel steel.

Steel Building Construction

The completion of the Equitable Building, New York City, now in course of construction, will be a notable event in that it will usher into existence the largest office building in the world. With three storeys below ground, 36 main storeys and two intermediate storeys, it occupies a ground space of a little more than an acre, so that it will afford a floor space of nearly 40 acres. The cross-sectional area of the largest column is 393 sq. in., as against a maximum column section of 700 sq. in. in the 57-storey Woolworth Building.

Unfortunately, space does not permit reference to some of the many other notable building operations recently completed or now in progress.

IMPORTANT LINES OF FUTURE PROGRESS

Alloy Steels

With the materials now available for structural purposes, a span of about 2,000 ft. may be regarded as the maximum practicable limit for cantilever bridges. For longer spans recourse must be had to some form of suspension bridge. Signs are not wanting, however, that we are on the eve of important developments in the field of alloy steels. With more exhaustive investigations of their possibilities, improved metallurgical and manufacturing processes, and substantial reductions of cost, alloy steels are destined to become factors of increasing importance in the design of long-span bridges; nor is it improbable that they will in time displace carbon steel entirely for structural and many other purposes.

In the meantime, it is interesting to note that the material problem has been variously met in the important bridges included in this review, although in part under radically different determining conditions, by the adoption, separately or in combination, of standard carbon steel, higher-carbon steel, high-silicon (and high-manganese) steel, nickel steel, and "Mayari" steel. The last, a natural alloy nickel-chromium steel, will be used extensively, and for the first time for structural purposes, in the Memphis Bridge and the high-silicon steel in the Metropolis Bridge, for compression members only.

Since the moduli of elasticity of alloy steels and carbon steels are practically equal, elastic deformations and, therefore, deflections and secondary stresses, will be emphasized with the increased unit stresses. This element will require careful attention both in design and erection, but is not likely to entail difficulties of governing weight.

Full-Size Tests

The need of extensive full-size tests on steel compression members remains almost as great as ever, although the tests on models of Quebec Bridge members have yielded some valuable data. The returns from the tests by the Bureau of Standards, now in progress under the joint auspices of committees of the American Society of Civil Engineers and the American Railway Engineering Association, are awaited with great interest. Much full-size experimental work, both in tension and compression, will be needed before the relative merits of the various alloy steels can be safely judged.

Observations on the Elastic Behaviour of Structures

It seems highly desirable to perfect means of ascertaining not only the dead and live-load stresses in important structures, but also the secondary stresses, within fair limits of accuracy through observations on their elastic movements. On the Beaver and Winner bridges permanent contact points for extensometer measurements were established before their erection some years ago, but the results from subsequent observations have not been publicly disclosed. It is to be hoped that the experience had with these tests will be fully reported with suggestions for overcoming any difficulties that may have been unexpectedly encountered. The fact that within the elastic limit of the material every member is practically a perfect spring under axial stress, should lead to valuable developments, especially under static loading, in this important though singularly neglected field.

It is also to be hoped that the important investigations, by committees of the American Railway Engineering Association, on secondary stresses and on the effect of "impact" on the stresses in railroad bridges will be actively continued.

Load Assumptions

The opinion that, with present clearance, Cooper's E-60 loading will be ample for future needs and that possible increased traction requirements will be met by engines of the Mallet articulated type, which assure a more favorable distribution of the loading on bridges and track, seems to be well-grounded. In some quarters provision for somewhat increased clearances for new bridges is advocated as precautionary measure against possible future needs.

The question of rational assumption as to live loading for large multi-track bridges, in which the conditions may be further complicated by wide stretches for highway traffic, still presents, however, one of the most perplexing problems with which the structural engineer has to deal. This is especially true for types of structures, including cantilever bridges, in which the conditions for maximum stress in certain members require the concurrent full loading of two or more parts, with the intervening parts wholly free from load. It is hardly to be doubted that live-load assumptions have occasionally been made whose realization is scarcely more likely than an earthquake visitation. This question is of such fundamental importance that it is not only worthy of much greater study than it has heretofore received, preferably on the part of a well-chosen committee, but it also points to the desirability of systematic traffic studies on important existing bridges, for the gradual accumulation of authentic data as an important step towards gauging present and probable future needs.

The rapid corrosion of steel structures exposed to the gases and blast of locomotives is now prevented by incasing the exposed parts in concrete. But the great problem of steel protection in general, under ordinary conditions of exposure, remains unsolved. New discoveries as to properties of alloys, and recent radical improvements in the application of metallic coatings, may yet lead to a practical solution in that direction.

A high wind lifted a steel stack at the Flatbush Water-works, Brooklyn, N.Y., and carried it 50 ft. through the air, dropping it through the roof of a house, where it fell through the ceiling into the room below. No one was hurt. The stack spent the night in the house. The next morning derricks were placed for its removal.—Engineering News.

The Steinway Tunnel, a tube extending from Long Island City under the East River to the Borough of Manhattan, New York, will be open for travel April 1, according to a recent statement by Mr. Theodore P. Shonts, President of the Interborough, who said that a temporary service would be started at that time. Trains from Jackson Avenue, Long Island City, will run to a temporary station at 41st Street and Lexington Avenue, Manhattan. The tunnel has been practically completed for several years, but never opened because of litigation.

Additional Facts Emphasized by the Edison Fire

THE destructive fire which occurred last month at the plant of Thos. A. Edison, Inc., West Orange, N.J., again emphasized some essential requirements of so-called fireproof buildings, comments Engineering and Contracting, editorially. Although this fire may well be carefully studied by engineers and architects we do not believe that the findings of investigating bodies will disclose facts which are not already known. They will, however, undoubtedly disclose facts which continue to be disregarded by some engineers and architects. In the area affected by the fire two types of buildings were in general use—brick buildings with steel beams and roof trusses, and those constructed of reinforced concrete. The building in which the fire started was used for film testing, and it was a one-story structure with sheet metal covering. The buildings were closely spaced, which made it impossible to stop the progress of the fire with the inadequate facilities at hand. As a result of this disaster the brick buildings and their contents were completely destroyed, while the contents of the reinforced concrete ones were destroyed, and in many cases the columns either were destroyed or were badly damaged. In general, the reinforced concrete floors and walls effectively resisted the fire, the damage to them being due mainly to the failure of the columns.

Even though the contents of the buildings were highly inflammable, and the fire hazard was known to be great, the reinforced concrete buildings were fitted with wooden sash and plain glass windows. Moreover, there was a decided lack of fire walls, the buildings generally being open and with few partitions. There were also open elevator shafts and some unprotected stairs. Finally, the buildings were not equipped with automatic sprinkler systems, even though the water supply for fire-fighting purposes was inadequate.

It has been demonstrated by many fires that no building which contains wooden frames and plain glass windows should be classed as a fireproof structure, as it neither can retard a fire originating from within nor can it offer protection in case of a fire in adjacent buildings. The automatic sprinkler system has also proved its worth as an effective means of protecting the contents of a building. Furthermore, the value of fire walls and of enclosed shafts for elevator openings is generally recognized. In view of these facts any engineer or architect is inviting severe and merited criticism if he does not strongly impress upon the prospective builder the need of recognized fire protection measures for buildings of this character.

The so-called rodded columns, without spiral reinforcement or efficient hooping, should not be classed as a reinforced concrete member. The columns in the reinforced concrete building affected by this fire were of the rodded type, as is evidenced by photographs of numerous columns which failed. The vertical rods simply bent out of line as soon as the outside layer of concrete fell away and thus left nothing to resist the horizontal shear—the characteristic failures being along diagonal lines. Although the water thrown upon these columns undoubtedly contributed to their failure, total failure would not have occurred in at last some of them if horizontal shear reinforcement had been provided. It should be remembered by designers that the columns are the vulnerable points in destructive fires, and that the utmost care should be exercised in their design and construction.

Sewage Disposal by Means of Electrically-Driven Pumps at Chilliwack, B.C.

Specially contributed by D. Penzer Dunn, A.I.E.E.

CHILLIWACK, the capital city of the Municipality of Chilliwack, is situated in the Fraser Valley, on the transcontinental lines of the Canadian Northern Railway and the Great Northern Railway. It is seventy miles from Vancouver, B.C., and fifty-eight miles from New Westminster. The city is the eastern terminus of the British Columbia Electric Railway inter-urban line, on which several electric trains run daily to and from Vancouver, New Westminster and the intermediate points. The population of the city, which is increasing, is 2,500 and of the municipality 6,000.

The water is brought down from a mountain stream some eight miles away from the city. This water is laid on practically all the roads throughout the Valley. Electric light and power are furnished by the B. C. E. Ry. Company, Limited. A local company supplies telephone communication throughout the city and surrounding district and gives long distance connection with coast points.

The Chilliwack Valley stretches from Sumas Lake on the west to the foothills on the extreme east, a distance of twenty miles. The Valley is about six miles wide at its broadest point. It is drained by the Fraser River, which flows along the North-West side. The soil for the most part consists of loam, it being a mixture of river sediment with volcanic washings from the Coast Range of mountains. The soil has a depth of from three to ten feet, and is rich in phosphates. The sub-soil is silt. Sand and gravel form the medium of natural sub-irrigation. The climate is temperate and extremes are not general. The rainfall is fairly heavy during winter, the average annual rainfall for a period of ten years being 62 in. Electric storms seldom occur, and irrigation is not required. The chief industry of the Valley is dairying. Fruit growing and poultry farming are also followed with success.

Two of the motors at the Chilliwack plant. Not witch board and automatic oiling system.

For some years the city has desired to have a proper sewer system, the old system of installing septic tanks throughout the district having become a nuisance in times of heavy rains during the winter months, and a menace to the public health—owing to the overflowing of these tanks. Further, no provision could be made for installing storm drains to take off the surplus water during such times. In the beginning of 1914 the city decided to install a sewer system and called for tenders and plans. The work was intrusted to Messrs. Cleveland & Cameron, civil engineers, of Vancouver, who let the contract to Messrs. Robt. McLean & Company, general contractors, Vancouver, B.C.

The original scheme provided for the use of pneumatic ejectors at two or more points within the district, this being afterwards discarded owing to the prohibitive cost.

In the summer, during high water from the Fraser River, when the rise is extreme, the level of the city is below the level of high water. However, a most efficient system of dyking was constructed some years ago, the defence work surrounding the greater part of the city. The average formation in the city consists of depths of from seven to nine feet of alluvial deposit overlying quicksand and gravel. Where the alluvium is of sufficient depth the work of sewering is about as easy as it is in any formation, but where the depths of the sewer penetrate the sand and the gravel the work becomes one of extreme difficulty. The necessity of providing for the draining of basements in the business part of the city causes the sewers to have to be laid to a depth of over ten feet, which, for a considerable length, is below the quicksand.

The project that is being carried out consists of outfall works, placed at sufficient height, a pumping chamber at the lowest point in the district, and a series of sewers ranging from 12 in. to 6 in. in diameter with a rising main from the pump well to the outfall works. The scheme is on the separator system of sewerage and the cost of the works is about $35,000. The work was started about the commencement of May, 1914, and finished toward the end of December of the same year. The sewers are constructed with vitrified pipes, jointed with cement, with the usual manholes built in concrete at intersections and changes of gradient. The pumping chamber is constructed of concrete and the upper portion contains the pumping machinery. This consists of centrifugal pumps, in triplicate, supplied by the Canadian Fairbanks-Morse Company, Limited, of Vancouver, B.C. The pumps are driven by induction motors of the squirrell cage type. The sewage from that point is delivered by the rising main to the outfall works on land onto the bank of the Lily Slough.

Each pump has a capacity of 200 gals. per minute against a total head of thirty-three feet. The outfall works consist of detrital chamber and separator in duplicate, each being provided with controlling valves for alternating the flow and removing the solids. The detrital tanks are of the usual hopper bottom shape with surface scum boards. The separator consists of the same hopper shape pattern, the outlet from them being by a series of weirs and channels drawing the liquid from the top by a series of thin films. With this combination over 90 per cent. of the solids in suspension are removed. The effluent is sufficiently clarified to be discharged into a stream or used for further purification on filters. The detrital tanks and separator are built entirely of concrete. The scheme provides for the sewage from a population of five thousand at the rate of 100 gals. per head per day. This system is the only one of its kind operating in British Columbia and it is quite a success.

The grading of the main sewer piping throughout the city varies from .22 to .45 per cent. The distance from the centre of the city to the pumping chamber is, roughly, 6,000 ft., and from the chamber to the separator tank 4,000 ft., the average grade of the rising main being .034 per cent. The total loss in friction in the pipes, pumping equipment, etc,, amounts to 5 per cent. The amount of head that the pumps have to contend with at the pumping chamber is 15.8 ft. This includes losses, while at the separating tank an additional head of 11.32 ft. is encountered. In the rising main about 1.36 ft. is lost owing to friction. Thus the total head for the pumps to operate against is 28.48 ft., say 28.5 ft.

Considerable difficulty was encountered in laying the pipes in certain portion of the city, owing to the quicksand in the lower strata. On several occasions after the pipes had been laid and filled in, a cave-in occurred in the roadway which necessitated its being torn up and renewed. To offset this difficulty, sheet and stool piling had to be resorted to. In some cases this was driven down to a depth of from 15 ft. to 20 ft.

During the construction of the pump chamber, which is of solid reinforced concrete, with walls one foot thick and a total depth of 21 ft., resting on a natural gravel formation, an excavation had to be made 20 ft. x 25 ft. and 21 ft. deep. This took several weeks to complete owing to the difficulty of getting rid of the water, which appeared at only three feet below the ground surface. A centrifugal pump operated by an eleven horse-power induction motor, with a speed of 1,130 r.p.m. and a pump capacity of 300 gals. per min., was in continuous operation. At certain periods two gasoline-engine-driven plunger type pumps of 5 h.p. each were used as auxiliaries.

Bottom chamber where pumps are located.

During the laying of the concrete foundation, the blowholes kept appearing. This difficulty was overcome by plugging with a half-inch iron pipe and then filling with cement. Two manholes extending two feet above the road surface are provided—one for lowering machinery into the chamber, and the other for the inspection of apparatus. On completion, the chamber was subjected to a 48-hour test for leakage and completely submerged. This was done to satisfy the city officials, who declared it to be quite watertight.

The Erie Pump & Engineering Works, of Erie, Pa., manufacturers of sand gravel dredging pumps and general contractors' pumps, have been consolidated with the Northern Equipment Company, Erie, manufacturers of the Copes boiler feed water regulators and governors. The name of the new organization is the Erie Pump & Equipment Company, the officers of which are Mr. E. W. Nick, President and Treasurer; Mr. D. H. Du Mond, Vice-President, and Mr. V. V. Veenschoten, Secretary. Mr. John Dougherty, for many years designer of centrifugal pumps with the Jeansville Iron Works, will have charge of the designing of pumps for the new firm.

During last year the town of Outremont, P.Q., issued building permits valued at $874,050.

Personal Mention

Mr. H. A. Lumsden, of the Ontario Department of Public Works, has prepared a report on road macadamizing from Owen Sound to Collingwood, a distance of thirty-eight miles. The estimated cost totals approximately $167,000.

Mr. Geo. T. Clark, Vice-President of Richardson Builders, Limited, Engineers and General Contractors, Winnipeg and Saskatoon, has been appointed by the Department of Public Works at Ottawa to superintend the excavation for the new Saskatoon Post Office. The work has already commenced.

Mr. Adolph F. Meyer, Associate Professor of Hydraulics in the College of Engineering of the University of Minnesota, has been engaged as consulting engineer for the International Joint Commission in connection with the investigations made on boundary waters between the United States and Canada.

Mr. R. D. Johnson, formerly hydraulic engineer of the Ontario Power Company of Niagara Falls, and Mr. P. Wahlman, formerly chief engineer of Compania Hidro-Electrica de Tucuman, Argentina, South America, have opened an office at 60 Wall Street, New York City, to engage in consulting hydraulic work.

Mr. D. O. Lewis, the newly elected Chairman of the Victoria Branch of the Canadian Society of Civil Engineers, occupies the post of District Engineer of the Canadian Northern Pacific Railway, he being in charge of location and construction of the Vancouver Island line. He has had a long and eminently useful connection with railway work, his professional career having started in 1882 with the Canadian Pacific Railway, in whose service he continued until 1903, when he joined the Canadian Northern. Starting as a topographer and transit man, he has occupied in turn the offices of resident engineer, division engineer, road master, bridge and building master, locating engineer, engineer of maintenance, and, finally, district engineer.

Mr. Thomas Adams, Town Planning Adviser to the Commission of Conservation, delivered an address on Town Planning before the Canadian Club of Montreal last week. Mr. Adams predicted that within a quarter of a century the population of Montreal will be 1,500,000. He urged the authorities to draw up definite plans for future development of the city. Montreal, he said, had a magnificent site, but definite plans were required for future development, in order to avoid the mistakes of the past. In 1881 only 14 per cent. of Canada's population was urban; to-day over 50 per cent. lived in towns and cities. Between 1901 and 1911 there had been 4,568 industrial establishments created in the Dominion, while in the latter year some $250,000,000 had been paid out in wages in manufacturing industries. In Quebec province alone during the decade manufacturing establishments had increased from 4,845 to 6,584, when an increase in employees from 110,000 to 158,000. In such circumstances it was evident that the human factor should be given full consideration, so as to secure efficiency.

The death of Mr. Thos. Coltrin Keefer, C.E., C.M.G., which occurred at Ottawa on January 7th occasioned widespread regret throughout the Dominion. The late Mr. Keefer was one of the best known engineers in Canada, and was highly respected in the profession. He was one of the founders of the Canadian Society of Civil Engineers, and was a past president of the American Society of Civil Engineers. He was Commissioner for Canada at the London Exhibition in 1862, and at the Paris Exhibition in 1878. In the latter year he was made a C.M.G. and also an officer of the Legion of Honor. The late Mr. Keefer was born in St. Thomas, Ont., in November, 1821. He was the son of George Keefer, a descendant of the United Empire Loyalists.

Mainly Constructional

East and West—From Coast to Coast

The Montreal Water and Power Company have now in use one section of the new reservoir, Outremont, described in our last issue.

At Regina, Sask., last year building permits were issued to the value of $1,776,000. This compares with a total of rather more than $4,000,000 for 1913.

The new post office at Quebec, the estimated total cost of which is placed at $500,000, is well advanced towards completion. The architect in charge is Mr. E. M. Talbot, of Quebec.

The Montreal City Council have voted $1,500 for an expert to assist Mr. G. R. MacLeod, the civic tramways engineer, in preparing plans and estimates for a proposed tunnel under the Lachine Canal.

At Ottawa, the ratepayers have passed a by-law authorizing the expenditure of $400,000 on extensions to the waterworks. The Acting City Engineer is Mr. F. C. Askwith and the Water-Works Engineer is Mr. R. L. Haycock.

At Saskatoon, operations have commenced on the new post office, a stone and brick building which is to cost $100,000. The excavation is under the supervision of Mr. Geo. T. Clark, of Richardson Builders, Limited, Saskatoon.

Windsor, Ont., is awaiting the announcement of the United States Hotel Company, who propose to erect in that city a building costing $250,000. According to present plans, the hotel will be six storeys high and will contain 115 rooms, with four storeys in the front, and a basement.

The new St. Charles Hotel at the corner of Bay and Richmond streets, Toronto, is nearing completion. The building, which is three storeys high, of terra cotta and brick construction, has been erected by Mr. J. J. O'Neil, according to plans prepared by Mr. J. P. Hynes.

From the Siemens Company of Canada, Limited, we have received a most interesting and useful pocket diary for 1915. Ample space for memoranda, cash accounts, etc., is prefaced by interesting information concerning some of the many well-known products of the firm.

At Ottawa, the ratepayers have approved a by-law to raise $100,000 for the erection of a municipal abattoir. The architect is Mr. R. Percy Sims, of Montreal, whose interesting article descriptive of the Maisonneuve public market was a feature of our issue of January 6. Plans for the Ottawa abattoir have been approved.

It is stated that contracts will shortly be awarded for Sections 6 to 9 of the Welland Ship Canal. Five sections are now under contract, and nearly 3,000 men are engaged on the work, which will continue all the winter unless exceptionally severe weather sets in. The prediction that the Canal will be completed in 1918 still holds good. The whole project involves an outlay of $50,000,000.

The Strachan Bakery, the constructional features of which were discussed in our issue of December 23rd, has reached the roofing stage. The new work is an addition to the plant, which has been built at a cost of $100,000. The structure is four storeys high, of reinforced concrete, terra cotta and brick construction. The architect is Mr. Sydney Comber and the general contractors are Messrs. P. Lyall & Sons' Construction Company, Montreal.

A Notre Dame de Grace syndicate, Mountain Sights, Limited, is seeking the issue of a writ of mandamus, to compel the City of Montreal to construct a boulevard four miles long, running from Snowdon depot, Notre Dame de Grace, to the Cote de Liesse Road. The work would involve the expenditure of at least one million dollars, and the action of the syndicate is being strenuously opposed by the city. The matter is at present in abeyance in the Courts.

The Provincial Department of Public Works of Manitoba has entered upon the construction of the Rover street wharf, Winnipeg. The structure will be 400 ft. in length and 30 ft. wide, and will be built of tile. The total expenditure involved is between $85,000 and $90,000. This work is part of a much larger scheme for the improvement of the Red River. At the present time a survey is being made between Selkirk and Lake Winnipeg. Last year the expenditure in this connection was $400,000.

The Quebec Government promises further legislation in connection with the policy of constructing roads throughout the province. The extent of the good roads movement is indicated by the following summary. In 1914, there were 196.68 miles of gravelled roads made and 550 miles of macadamized roads. In 1914, 7,500 men were employed during four months of the year, and from July, 1914, to December of the same year the Provincial Government spent for the improvement of roadways of all descriptions the sum of $4,354,565.

In connection with the bridge which the Burrard Inlet Tunnel and Bridge Company propose to erect over Second Narrows, a contract was awarded recently to the Canadian Bridge Company, Walkerville. This contract has now been cancelled and tenders will be called later, after new plans have been prepared. The proposed bridge is to be all steel and concrete construction, with a centre span of 225 ft. The estimated cost is nearly two million dollars. The engineers are Messrs. Cleveland & Cameron, and the consulting engineer is Sir John Wolfe Barry, Lyster & Partners.

As the Welland Canal is not large enough to admit the larger lake steamers the Dominion Government in 1905 began the erection of an elevator at Port Colborne, at the Lake Erie entrance to the canal, to tranship the grain from the large lake steamers to the smaller canal steamers which carry it to Montreal. The elevator began operations in 1908 with a storage capacity of 800,000 bushels. The demand for storage and transhipment increased so rapidly that the Government decided to build the new elevator, enlarging its capacity to 2,000,000 bushels; it will be completed early in 1915 at a cost of $1,750,000. Its facilities will be such that a steamer of 400,000 bushels' capacity can discharge in ten hours, and a canal steamer carrying 80,000 bushels can be loaded in about one hour.

Notwithstanding the retrenchment going on both in commercial and civic life, considerable work is proceeding at Victoria, B.C. The $125,000 First Presbyterian Church is about completed. Work is proceeding without delay on the drydock, the cost of which will be much over $1,000,000. A $300,000 bridge will soon be erected by the city jointly with transportation companies over the Johnson Street arm of harbor. An $8,000 manual training school is to be erected immediately. An $18,000 paving plant, the property of Warren Bros., of Boston, Mass., has just arrived to complete the contract made by the Canada Mineral Rubber Company to pave thirty miles of streets in Victoria with asphalt. Most of the work has been completed, but there is a certain amount to be finished, which will be completed immediately. The Hudson's Bay Company has given positive promise that its new department store, costing $400,000, will be erected without delay. The Government proposes to continue the harbor dredging the same as originally planned. This work is considerable and will last several years.

The Ottawa Water Supply

THE following judgment was delivered by Mr. Justice Middleton in declaring that the Provincial Board of Health exceeded its powers in rejecting Ottawa's $2,000,000 water supply project, involving mechanically filtered water from the Ottawa River, and substituting for it Sir Alexander Binnie's project of a supply from Thirty-One Mile Lake, at a cost of $8,000,000.

"It is quite apparent," said Judge Middleton, "that the board has acted upon the assumption that it was justified in refusing to approve of the plan because the scheme propounded by Mr. Currie (essentially the Hazen filtered river water plan) did not meet with the approval of the board. It is manifestly a matter of vital importance that the city of Ottawa should sevure a proper water supply. Whether it is necessary to spend $2,000,000 or $8,000,000 for that purpose must be determined by those upon whom the responsibility is placed.

"The Legislature submitted the choice of the scheme to the ratepayers. They chose the less expensive scheme. By this act the Legislature has entrusted the Board of Health with certain duties and I must determine upon the construction of the act whether the board was given power to review the action of the ratepayers and to disallow the scheme of which the ratepayers have expressed their approval or whether the board was only given the more limited power of dealing with plans and specifications submitted for the carrying out of the approved scheme.

"It seems to be clear that the board has gone beyond what was referred to it by the statutes when it assumed, as it undoubtedly has, to criticize and reject the engineer's report upon the source of water supply. If it was intended that the board should have the power to strike at the root of the whole scheme by rejecting the river as the source of water supply, it is hardly conceivable that the municipality would have been directed to prepare and submit to the board detailed plans and specifications which, I am told by counsel have cost the municipality upward of $30,000.

"I think the board has failed to discharge the precise duties imposed upon it by the statutes and that the mandamus should be granted."

The Montreal Building Code

THE Montreal code of new building by-laws, which have been under consideration for a very long time, and which were prepared by Messrs. Francis & Venne, will soon be in operation. In connection with this subject, and the amendment of the existing code, a correspondent calls our attention to the enforcement of the by-laws relating to theatres and moving picture halls. Section 99 of by-law No. 260 of the present code, passed in February, 1902, reads: "Every building hereafter built or altered to be used as a theatre for dramatic, operatic, or other similar purposes, involving the use of a stage with moveable or shifting scenery, curtain and machinery, shall be a first-class building, and the highest part of main floor of auditorium shall not be over seven feet above the level of the street or pavement on which the doors of exit are located." In the definition of terms, a first-class building is defined as a building of fireproof construction throughout. Our correspondent points out that notwithstanding this by-law, buildings used for theatres and picture halls were erected which were not fireproof, and that the Council nullified to a certain extent its own by-law by passing on October 6, 1913, the following amendment: The provisions of sections 99, 100, and 102 shall not prevent the owners or occupants of buildings used as amusement halls and which, since the adoption of by-law 260 have been altered to be used as theatres, from operating such theatres, provided that the alterations made for such purpose be, in the opinion of the building inspector, sufficient for the safety of the public. The present by-law shall form part of by-law No. 260, which it amends, as to the penalty and to all other intents and purposes."

This amendment was passed while the new code was pending, and our correspondent is of opinion that the Council's action weakened the very stringent clauses of the old by-law, necessary for the public safety. Whereas under the original section, it was compulsory to erect fireproof structures, the amendment allows the building inspector to be the judge of the sufficiency of means taken for public safety.

Municipal Work at South Vancouver

THE Annual Report of Mr. S. Barlow Bennett, City Engineer of South Vancouver, reflects considerable activity in the Works Department of that municipality during the year 1914. Of the various street improvements, mention may be made of the paving of Main Street, which, from 16th Avenue to 51st Avenue was laid with 4-in. wood blocks on a 6-in. concrete base. This was laid to what is known as "lath construction," the contract having been carried out by the Dominion Creosoting Company, Limited. This construction is said to give a better and firmer surface, besides making the road impervious to moisture. Bodwell road was paved with bitulithic surface, laid on a 5-in. concrete base. Joyce road, from Wellington avenue to Price street, was paved with a patent paving material known as "Lithtar." In the last instance the road bed was prepared by the municipality, while the mixing and laying of the pavement were carried out by Messrs. Harrison & Wall.

Mr. S. Barlow Bennett, City Engineer of South Vancouver.

Last season the South Vancouver Council granted the sum of $500 to form the nucleus of a testing laboratory. A cement testing machine, a penetrometer and other equipment were obtained, with the result that many satisfactory tests were conducted.

The streets were oiled efficiently, at a cost of $2.660, this representing the expenditure on 24 miles of surface.

Mr. Bennett recommends the extension of the day labor system, and expresses the opinion that excellent results should follow a judicious expenditure on the equipment necessary to carry out municipal work.

A summary of the work done is as follows:—Streets cleared and rough graded, 7.790 miles; lanes cleared and rough graded, 6.508 miles; streets graded, 2.147 miles; streets rocked, 2.813 miles; lanes rocked, 4.830 miles; streets paved, 2.724 miles; streets planked, 1.052 miles; streets ditched, 2.957 miles; box drain laid, 2.594 miles; cement pipe storm sewers, 5.090 miles; A.G. tile, 1.040 miles; bulkhead, .524 miles; three plank walks, 7.139 miles; concrete and stone curb, 5.22 miles; streets oiled, 24.01 miles; wooden catch basins, 112; concrete catch basins, 78; concrete manholes, 50; vitrified pipe culvert, 1; concrete culvert, 1.

Course of Lectures in Road Construction

A course of lectures in Highway Construction has been determined upon by the Honorable Finlay G. Macdiarmid, Minister of Public Works for Ontario, for the benefit of county road superintendents constructing roads under the Highway Improvement Act, and subsidized by the Provincial Government.

The course will be arranged by Mr. W. A. McLean, Chief Engineer of Highways, and the several subjects will be dealt with by assistant engineers of the Department. All county councils will be asked to send their road superintendents or engineers. While applying more directly to county road work, the various subjects will be of general interest. All municipalities are, therefore, invited to send their road or street superintendents should they so desire. The lectures will be given in a Committee Room of the Parliament Building, commencing—it is expected—Tuesday, February 23rd, and closing Friday, February 26th.

The subjects to be dealt with will be as follows:—Types of Road for the Open Country; Road Location and Grading; Alignment, Straightening, Hills, Sub-base, etc.; Drainage of Roads; Geology of Road Materials; Care of the Roadside; Departmental Regulations; Gravel Roads; Stone Roads; Concrete Roads; Bituminous and Brick Roads; Culverts; Bridges and Abutments; Maintenance and Repair of Roads; Machinery and Operation; Quarrying and Explosives; Cost-keeping, Road Accounts and Reports; Traffic and Modern Road Construction; Dust-laying; Cost Estimates.

The lectures will start at ten o'clock each morning, and will be illustrated by lantern slides. Following each lecture the subject will be open for discussion by the county engineers and superintendents.

It is intended to make the course of lectures thoroughly practical in all particulars, and all municipal road superintendents and engineers should as far as possible avail themselves of the privilege offered them. Any further information may be obtained from Mr. W. A. McLean, Chief Engineer of Highways, Parliament Buildings, Toronto.

American Concrete Institute

Additional particulars are to hand concerning the Eleventh Annual Convention of the American Concrete Institute. The meeting, which is to be held at the Auditorium Hotel, Chicago, from February 9th to 12th, will mark the completion of the tenth year of the existence of the Institute. On the opening day, Tuesday, February 9th, sessions will be held at 10 a.m., 3 p.m., and 8 p.m., when various routine business will be transacted and addresses given by prominent engineers. Papers and discussions on this date will relate to Concrete Roads and Bridges. On the second day, after various committees have reported, the subject of Concrete and Reinforced Concrete Tests and Design will be taken up in a number of expert papers. "Concrete in Art and Architecture" will be the subject for discussion on the third day, Thursday, February 11th, at the opening session of which a special committee, of which Mr. Cass Gilbert is Chairman, will report on the Edison fire. In the evening the annual banquet will be held. The closing day will be marked by the presentation of practical discussions on plant management and costs. In the morning Mr. T. A. Smith, General Superintendent of the Turner Construction Company, New York, will read a paper on "Contractors' Equipment." This will be followed by a paper "Mechanical Plant for Handling Concrete," by Mr. W. P. Anderson, President of the Ferro Concrete Construction Company, Cincinnati. Other papers to be presented at this session are: "The Strength of Concrete Forms" by Harrison B. Taft, Contracting Engineer, Seattle, and "Concrete Forms for the Catskill Aqueduct" by Alfred D. Flinn, Deputy Chief Engineer, New York Board of Water Supply. At the closing session, which will be held at 3 p.m. on Friday, February 12th, an interesting feature will be the report of the Committee on Methods of Tests and Standard Specifications for Concrete Materials.

Book Reviews

The Use of Water in Irrigation.—By Samuel Fortier. Published by the McGraw-Hill Book Company, New York City. Price, $2.00 net. The author of this book has had extended experience as Chief of Irrigation Investigations in the Office of Experiment Stations of the U. S. Department of Agriculture. The work deals with the agricultural side of irrigation, and is designed to be helpful to settlers, irrigation farmers and engineering students. The subject matter is confined almost exclusively to the problems which confront the irrigator. Considerable space is devoted to an explanation of the methods of preparing land and applying water. It is noted that considering the rich soil and favorable climate of arid America, the average yields under irrigation are small, this being due, mainly, to the adoption of faulty methods in watering fields and in maintaining moisture conditions in the soil. There are chapters in this useful work which cannot fail to be helpful to the engineering practitioner in the agricultural districts of the West.

Construction of Masonry Dams.—By Chester W. Smith Published by the McGraw-Hill Book Company, New York City. Price $3.00. This book, which is illustrated by many excellent half-tone and line drawings, has been written from the viewpoint of the constructing engineer,—a fact which will commend it to many of our readers. While a great many volumes have been written upon the design of masonry dams, this is perhaps the first that supplies adequate details of construction and supervision. The work consists of nearly three hundred pages. Some idea of its comprehensive scope may be obtained from the subject matter of the various chapters, which is as follows:—Exploring the Site; Temporary Works for Stream Diversion; Preparing the Foundation; Masonry Construction; Quarrying; Face Work; Miscellaneous Features; Plant and Power; Installation Required and Power Consumption; Assembling Materials, Crushing and Mixing; Transportation of Materials; Probable Future Methods; Estimates of Cost; Partial List of Existing Dams with Descriptions and Costs.

From the Canadian Mining Journal we have received a copy of their 1914 manual, a handbook of information concerning the mineral resources and mining industries of Canada. Readers of the Contract Record will find this work a most valuable reference for information relating to iron, lead, zinc, gypsum, and other mineral products which enter into constructional manufactures. The manual is ably edited and well illustrated.

Messrs. Hazen, Whipple & Fuller is the new name of the firm which was formerly Hazen & Whipple, consulting civil engineers, of New York City. Mr. Weston E. Fuller, whose name is added, has served with the firm for a number of years, he having devoted most of his time to water supply and filtration problems. Mr. Chester M. Everett, for eight years an employee of the firm, has been taken into partnership.

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The Exportation of Nickel

THE measures taken some time ago by the Canadian Government in regard to the export of nickel were a step in the right direction, but public opinion has not yet been satisfied, neither has the responsibility of the authorities been fully discharged. It yet remains to be emphasized, despite the efforts of special interests to the contrary, that the export of nickel, except in its final and most valuable form, should be made as difficult as possible, and that refining plants should be established either by encouraging private capital to enter the field, or under Government management.

There has been much discussion of the question in the papers, and many fiery arguments have been adduced. Possibly in some quarters the case may have been overstated, but there can be no smoke without fire, and, in our opinion, the casus belli is indisputable.

We have refrained from entering the discussion, having felt that the matter was receiving able publicity in other quarters, but we feel called into the fray when we note the stand taken by our contemporary, the Canadian Mining Journal, which remarks in a recent issue that "to place an embargo on nickel matte outside the Empire would mean that we should export only enough matte to supply the Mond Company's smelter in Wales, close down large mines and smelters in the Sudbury district, throw many men out of work, and cut off a large source of supply of armament for the allies and friendly neutrals."

To the Canadian Mining Journal we should look for a satisfactory deliverance on this particular issue, but, unfortunately, the Mining Journal seems to have got hold of the wrong premise, and in various articles has taken the untenable position of placing the responsibility upon the public. No doubt newspapers and patriotic leaders would be willing to accept this responsibility, and could bring public opinion to bear so heavily that there would be no trifling with the matter—**had they the facts.** But intense secrecy and reserve is exercised by both the Government and the International Nickel Company.

The Mining Journal says: "The World asks that without any evidence that nickel is being shipped to Germany by the United States, we should forbid the export to the United States." Surely one would have thought that the onus of proving that nickel was not reaching Germany lay upon the Government, who could stop it, and upon the refiners who are profiting by the policy of non-interference. How can the public or newspapers prove what is going on in an immense plant which is hedged around by locked doors and a perfect system of commercial espionage? No one has said that sixty per cent. of Canada's nickel goes direct to German ports; this would be impossible because of the British fleet; what is said, is—that as nickel is necessary to Germany in her present peril, it is more than likely that it is going to her indirectly, just as copper is going to her.

Let us remember that apart from the immeasurable cost in lives, the expense of the war to Britain is $5,000,000 a day, and to Canada $1,000,000 a week. With the supply of nickel cut off from Germany, the war will stop sooner than otherwise. So that as a simple business proposition it would be much cheaper to pay the nickel company for their loss, and to support the people of Sudbury—about whom our contemporary is so much concerned—by paying their wages, than to let the nickel out of the country, and by so doing prolong the duration of the war. One must bear in mind the fact that a rifled gun is useless after it has been fired from fifty to one hundred times: it has to be replaced by a new gun in which nickel is used. If we do our best to deter the enemy from continuing the manufacture of these new guns, so much the better is the prospect of an early termination of the war.

A point in favor of not interfering with the present arrangement is said to be that the nickel company which exports its matte to Wales would get an advantage over the other company which sends its product to New Jersey. But there are many seeming injustices in war-time, and the relative advantage to rival operators must not be weighed when considering a war measure in the deadly struggle in which we are engaged.

It appears from the discussion of this nickel question that the commercial spirit is still dominant in Canada and powerful enough to prevail against the belief of the thoughtful persons who are persuaded that there are various ways in which we can assist the Empire to bring our great enemy to his knees.

As far as Canada is concerned, we need not be apprehensive: the world must continue to come to this country for nickel.

This question can not be closed until the Government comes forward with an active and immediate policy looking to the establishment of reduction plants in Canada. What steps are being taken?

Ottawa's "Leaning Tower"

FOR two or three years a large crack has been developing in the tower of the Victoria Memorial Museum at Ottawa, and in all probability the building will be closed shortly. The crack has been caused by the sinking of the foundations. It runs from top to bottom of the tower, as well as across the floor and ceiling, and if allowance is made for the number of times that it has been plastered, it is now nearly a foot wide. It extends through many of the offices, and has rendered extensive repairs to plumbing necessary. In reality, the tower is separating from the main structure, and sinking with a slight slant forward.

The Department of Public Works has called in experts to submit a report, and in all likelihood extensive repairs, if not rebuilding, will be necessary.

It is of interest to recall the fact that an examination of this fissure was made by the writer some three years ago, when he urged that protective measures should be taken immediately. Now the Government has on its hands a "leaning tower" to which the credit and interest of the one at Pisa do not attach.

The only Canadian-made railway in England has been constructed by Canadian troops at Salisbury. The roads, which were of a temporary nature, were all badly cut up owing to the heavy rains and the enormous traffic engaged in the hauling of supplies to the camps. Various members of the troops belonging to the engineering section were finding life dull owing to the continuous rains; consequently they undertook the construction of a light railway which would serve their various camps. A contract was awarded to Sir John Jackson & Company for the construction of this service railway, and Canadian engineers, many of whom are graduates of the universities of this country, were engaged in its construction. This is not all the Canadian engineers have done, for at Bulford and Larkhill they have had charge of the construction of a water supply system.

A Complex Situation

ELSEWHERE in this issue we publish an interesting paper dealing with the international Niagara Power situation. At the outset, the author, Mr. Arthur V. White, defines the situation as "complex," and as evidence of the complexity he adduces some interesting material bearing upon the possibility of international complications. He tells us that "the chief danger lies, not with the people themselves, but with the aggressiveness of powerful United States' commercial interests whenever they fear that their assets were jeopardized."

Mr. White discusses two Bills which have been presented to the United States Congress, which if enacted "will be of serious import to Canada." As Mr. White intimates, the growing demands of Canadian factories are causing concern on the other side of the border, and it is the open intention of those who are bringing forward these Bills, to import into the United States largely increased quantities of power generated in Canada. Of the various statements and reports quoted by Mr. White, none is more illuminating than that of Lt.-Col. Sanford. The candor of the following extract is refreshing: "There is no question but that Niagara power will soon be utilized to the fullest extent allowed by governmental restrictions. If advantage of the power, generated in Canada, cannot be had on the American side, manufacturers will be attracted to Canada by this cheap power, and the industries of this country will suffer accordingly. The effect of present restrictions on the importation of power is becoming noticeable. . . . . Manufacturers at present contracting for additional Niagara power must locate and are locating in Canada."

With every honest effort to avoid international complications, Canada must adopt protective measures and secure the unhampered development of her industries. It is gratifying, therefore, to learn that the Commission of Conservation have given the most careful consideration to this problem and that they are alive to the many slippery possibilities which jeopardize one of Canada's greatest national assets.

The Munster Grenchenberg Tunnel near Berne, Switzerland, was holed through on October 27, 1914. The tunnel is 5⅜ miles, or slightly longer than the Hauenstein base tunnel, which was holed through July 10. The new tunnel is located north of the Lotschberg tunnel on the main route to Italy via the Simplon tunnel. Its construction has taken three and a half years and its cost is about $5,000,000. When the tunnel is put in operation the railroad line will be shortened 10⅝ miles and the time of the journey lessened by forty minutes.

A certain writer has recently said: "There is nothing quite so grand as 'panic faith, 'faith in your bank,' 'faith in your industries,' 'faith in your governmental representatives,' 'faith in your country' and 'faith in yourself.'" Fear nearly always starts with the individual and is nearly always without reason. If everybody would determine to keep his head just now, the greatest prosperity this country has ever known will soon begin to poke out its head. Remember that when you are in a fire it is not safe to stand around idle. A wall might fall and crush you. Get busy with your little bucket of water and help put out the fire.

The Relationship of the Engineer to the Proprietor and Contractor

Staff Report of an Address Delivered in Toronto last week by Mr. M. J. Butler, L.L.B., C.M.G., President of the Canadian Society of Civil Engineers

ONE of the most essential aspects of engineering, viz., the co-operation of the Engineer, the Contractor and the Proprietor, was discussed last week, on the occasion of his visit to Toronto, by Mr. M. J. Butler, C.M.G., President of the Canadian Society of Civil Engineers, in an address delivered before some four hundred engineers and engineering students at the University of Toronto.

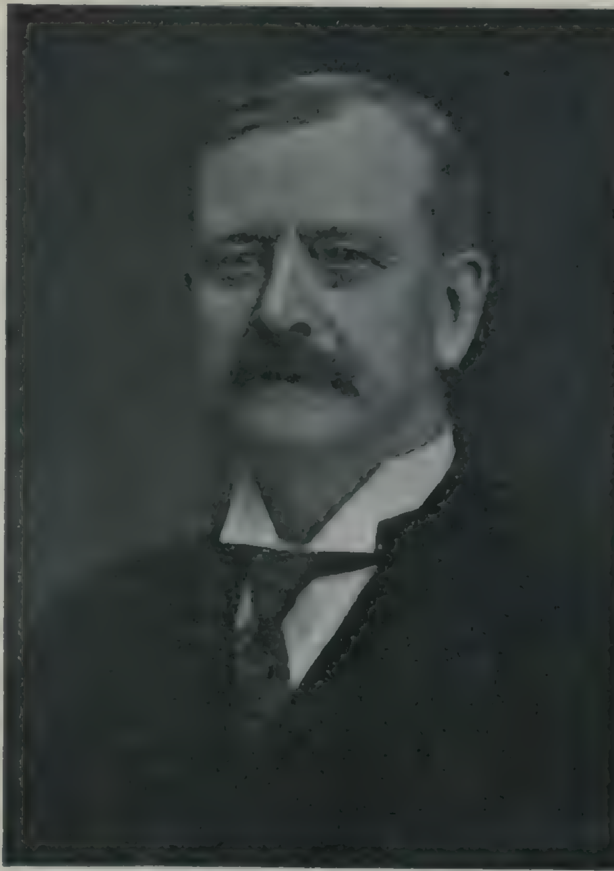
Mr. Butler said that the engineer stood between all contractors—between the proprietor on the one hand, to see that he got what he paid for, and the contractor on the other, to see that he received due payment for the work he performed. An engineer should ascertain what the essentials should be in regard to the drawing up of specifications.

Discussing the essentials of the specification, the speaker quoted examples wherein failure in this respect frequently led to trouble. The specification was nothing more or less than a detailed description of how the work it covered should be done and how the engineer wanted it done. He deprecated the tendency among engineers to copy from a set of rules in preference to drawing up original specifications. The latter course was naturally much more difficult. Specifications should be drawn with accuracy, and a definite effort made to describe what the work was to be, how it was to be planned, and how fair play could best be afforded to the man who was risking his money in the enterprise, and to insure to the contractor a fair return for his work—no more and no less. He counselled the young engineers to obtain the advice of their older and experienced brethren in the profession whenever any doubt existed as to what their course should be. By this means they would be able to perform more satisfactory work for their employer.

Dealing with the ideal specification, the speaker alluded to the Transcontinental Railway specification which had been prepared after many years of careful study, and after a good deal of experience in the work. It was a very complete specification, and contained all the clauses that need be found in any contract. He emphasized the need for the young engineer to familiarize himself with the essentials of a contract, the rules of interpretation and the form in which expression to these rules should be given. His remarks in reference to standard rules in the carrying out of a specification were highly illuminating. He referred to an instance in his career where a contract had been carried out most successfully although not a single one of the prescribed rules in the specification had been adhered to. The specification to which he referred called for concrete with one-man stone in the construction of an embankment, whereas the stone he utilized was of several tons weight. The result was a magnificent job, highly pleasing to himself and to the proprietor as well. He pointed out, however, that the intelligent interpretation of a specification was one that could only be accomplished after considerable study. He also referred to the necessary functions of the plans and specifications, giving a general outline of instructions to the bidder, in order that he might make a fair and intelligent bid. It was a mistake to give an engineer too much authority. At the same time he should be invested with power sufficient to place him in a position to determine points of engineering difficulty for he was much more competent to determine these than were the law courts.

Concluding a brief but highly instructive address, Mr. Butler stated that the most successful engineering work was that which combined good engineering with the economical expenditure of money.

Professor Gillespie, in moving the best thanks of the meeting to the speaker, referred to Mr. Butler's special qualifications for addressing them on a subject concerning the ethical and legal aspects of the question.


Mr. M J. Butler, L.L.B., C.M.G., Montreal.

Mr. E. D. Gray, President of the Engineering Society, seconded the motion, which was formally tendered by the Chairman, Mr. A. F. Stewart.

Pumps to handle storm water from a 9½-ft. concrete sewer are being installed at Sacramento, Cal. The sewer main enters the sump house below sea level, and the effluent is delivered under pressure through a 7½-ft. main into the Sacramento River. The sump house is being equipped with three 30-in. and two 22-in. pumps, and the building is planned so as to accommodate more pumps when the amount of water to be handled requires it.

Engineering Topics in the Old Land

Experimental Sections with Reinforced Concrete Roads—The Evil of Official Testimony Exemplified—Concerning "The Association of Consulting Engineers"—An Opportunity for the War Office

By the London, Eng., Correspondent of the Contract Record

Westminster, Jan. 16, 1915.

MENTION was made in a recent article of the fact that concrete roads had not been tried in this country, or at best that what trials had been made were unauthoritative or fugitive. Mr. H. P. Chapman, the county surveyor of Kent, England, has made a move in the right direction, and six trial sections of concrete road (towards which the Road Board is contributing) are now being laid. The concrete is to be a six to one composition, and is to be laid to a thickness of 6 in., and each section is to be of a length of 75 yards. The British Portland Cement Manufacturers, Limited, are supplying a specially prepared slow-setting cement, and the ballast is to be carefully washed and screened. It is unfortunate, perhaps, that the sections are all to be reinforced, and it would have been much better, for experimental purposes, if one section had consisted of plain concrete. Still, one must be thankful for partial mercies, and the wearing surface of a concrete road will be pretty severely tested. The reinforcement—Expanded Metal Company's diamond steel mesh, indented steel bars, the United States Steel Product Company's steel wire mesh, and the British Reinforced Concrete Engineering Company's "R.B.C." fabric—will be laid at from 1½ in. to 2 in. from the surface of the sections, and longitudinal and transverse expansion joints will be provided in every case. The result of the trials will be awaited with considerable interest in this country and may furnish some valuable data for Canada and the United States. Mr. Matthews Jones, the city surveyor of Chester, in his presidential address delivered before the Institution of Municipal Engineers last month, mentioned certain experiments that he had been carrying out in reinforced concrete roadways, which had given the greatest possible satisfaction, and he expressed the opinion that "all county main roads would be done on these lines in a few years."

Official Testimonies

Mention has just been made of the Road Board, as contributing to the trials being made by Mr. Chapman. The consulting engineer to the Board is Colonel Crompton, an electrical engineer, and in such capacity he has the final word in regard to road construction in all parts of the country. It is lamentable, therefore, to find him giving testimonials to firms of proprietary road materials. His views are never very definite, and he has boxed the compass more than once, and it must be difficult for him to steer clear of trouble. For example, only the other day he testified in glowing manner to the excellence of a material marketed by a certain firm of manufacturers of asphalt macadam, though whether (as has been questioned) he testified as the consulting engineer to the Road Board or as a private consulting engineer no one knows. In his testimonial he mentioned that he had, for the last two years, been "looking anxiously for methods of construction which would resist deformation in bituminous bound roads," and he has "no hesitation in saying that the best he has seen is" that of the firm to which he writes. "The twenty-seven months of traffic at Hoggers Corner" (his exact words are quoted) "leads me to believe that with a road constructed no worse than the one at Hoggers Corner, the life will be quite as great as that of the best asphalt laid on concrete, and I think, therefore, you are perfectly safe in taking contracts for ten years at trifling maintenance figures, which do not average more than 4d. per yard." Colonel Crompton can scarcely eat words such as these, remarkable as his digestive powers may be, and he is committed for all time to accept the material of this firm at his own assessment and recommend it to his Board. No man holding an official post should place himself in such a delicate position.

The Association of Consulting Engineers

It is difficult to find any real reason for the formation of this body of professional men, and despite the glowing statement that "this association is thoroughly representative as testified by the imposing array of prominent names appearing in the list of the managing committee," no illuminating ray of light is forthcoming. The Institution of Civil Engineers—with its offshoots representing mechanical and electrical engineering, gas and water—surely answers every requirement, even to the very definite safeguards for the preservation of professional etiquette. Were the Association for consulting engineers only, there would be good reason for its existence, but its members appear to be civil engineers and not men whose work is simply to advise. Its rules against soliciting work, against the payment of commissions, and against ousting brother professionals are all admirable, but they bring one no nearer to the condition of things sought after by every professional body. Even State recognition could not help in these three essentials, for members of the "recognized" professions are not against outraging the laws of etiquette, whether written or unwritten. As has been said in this column more than once, men must live, and to live they must work, and work will not fall into one's lap or rush in at one's office door. Even a brass plate fails as a client catcher, and the man who has no influence must remedy its lack by initiative and push. Attention was directed recently by the writer to the advertised appointment of an engineer to the Eastern Valleys (Monmouthshire) Joint Sewerage Board, for which engineers were requested to tender, stating qualifications and terms required. It was said then that "the man who tenders for this job runs the risk of reprimand, if not of compulsory resignation" from his professional society, and a circular has just been issued by the Institution of Civil Engineers strongly condemning the action of members of the institution who responded to the advertisement. Possibly the Association of Consulting Engineers would have shown the offending members the door!

The Proposed Municipal Engineering Corps

The proposal to form a Municipal Engineering Corps has been given some prominence in the Contract Record, and readers are referred to the article which appeared in the issue of September 2. As was then explained, the War Department practically turned the idea down, and now that it has been revived things are no forrader. The proposed corps was to consist entirely of municipal engineers, a body of specially trained men, who would be of the highest use in a hundred ways not only in the event of an invasion but at all times—in times even of peace—if they could be got to work together for certain specific purposes. They would form an intelligence department of the first order, and as regards technical work (to mention one instance only) had they been engaged in the construction of huts and hospitals the whole of the men in training might have had decent lodgment. Still, this is beyond the matter now, and the reason for reverting to the offer is that the War Office would consent now to the corps being raised and affiliated to the Central Association Volunteer Training Corps.

Brains vs. Brawn

This latter body consists of men unable to serve in the regular or territorial army, and it has to be entirely self-supporting. It may arrange for uniformity of dress (so long as no badges of rank are worn) but uniform may be worn only when necessary for training. The accepted military ranks and titles must not be used, and no oath of attestation is permitted. Army recruiting officers may "visit the corps at any time to recruit any members found eligible for service with the regular army whose presence in the corps is not accounted for by some good and sufficient reason." There is little to cavil at in much of this so far as ordinary volunteer associations are concerned, but with municipal engineers it is quite different. "To drill and to learn the elements of musketry in their spare time" was not in the mind of the promoters of the scheme, since the sphere of each individual would be his own district. As a matter of fact the whole thing is knocked finally on the head, and it remains for the municipal engineer only to join some local association where his specialist knowledge would be of no value at all—where, in fact, a man from the plough tail, might prove the better man of the two.

The Engineer Out in the World

[Paper presented by Mr. Martin Schreiber before Section D of the American Association for the Advancement of Science, at the Philadelphia meeting last month. In this paper the author outlines the requirements necessary for success **under the conditions prevailing in modern industry and discloses the broad field open to technically trained men who** can meet the demands of business. In our next issue we shall present an interesting discussion of this paper prepared by Mr. Harry Barker, of the editorial staff of the Engineering News. Mr. Schreiber is Maintenance of Way Engineer for the Public Service Railway Company, Newark, N.J. He is a Past President of the American Electric Railway Engineering Association.]

FIRST, it should be appreciated that the engineering profession, like all business, has been hard pressed to keep abreast of the times. Not only has the engineer been called on to keep pace with special industries, but positions have also been thrown open to him requiring economical, organization, financial and general business ability. Along with these duties a new field has appeared in public affairs. The great expanse of knowledge is in glaring contrast with what was expected of the technically trained men of olden ages.

During recent years considerable controversy has arisen relative to certain phases of the engineering profession. One important topic is that of the proper training of the engineer. This question necessarily involves the curriculum of the technical schools and a great deal has been written and said on the subject. While many argue for the college, some actually condemn the work as now carried on in the technical schools. The writer is firmly of the opinion that such questions as these, along with the proper compensation of engineers and others, may be intelligently considered only after we have analyzed the present-day field for the engineering profession.

Extent of Specialization

While the writer was attending a Board of Trade meeting one evening, a gentleman sitting next to him after some conversation, said that he manufactured heels for shoes and sold the heels to shoe manufacturers. It seemed strange at first thought that the shoe manufacturer should not make the heels as well as the rest of the shoe.

The factory of the Ford Motor Car Company at Detroit, probably one of the most complete of modern industrial establishments, by no means builds the entire product. The bodies, wheels, tires, carburettors, lamps, roller and ball bearings, grease cups, all drop forgings and minor parts are purchased from other sources. It is said that the drop forgings used by the Ford Motor Car Company amount in value to one-half of all the drop forgings used in the United States.

These are striking examples of how far modern specialization has actually successfully progressed.

The professions have followed the example of manufacturers in specialization. We have criminal, jury and corporation lawyers, the doctor of surgery, the doctor of diseases of the eye, ear and throat, and the doctor for babies. We even find diversion in professional dentistry, which in itself is somewhat of a restricted line. The public often recognizes one doctor of dentistry particularly skilled in the extraction of teeth, while another makes plates and bridges for the teeth and mouth.

Development of Profession

Engineering coming along with other professions is now made up largely of men trained along professional lines. At first we had only the engineer. Then came civil, mechanical, electrical and mining engineers. Not so long ago we frequently met men purporting to be combination civil, electrical or mechanical engineers. To-day anyone claiming such a field for himself would be liable to subject himself to ridicule, not only by engineers in general but the laymen as well. Nowadays, it is not only the civil engineer, but the up-to-date business demands electric railway, hydraulic, construction, bridge, building, tunnel, foundation, sanitary, highway engineers, and so on. Instead of the mechanical engineer we want the heating, conveying and hoisting, or the car equipment engineers. Likewise it is not only the electrical engineer that is required, but the illuminating, distribution or the testing engineer.

In general, a jack-of-all-trades is a thing of the past. What the public insists on is one who knows all there is to be known about one particular branch. The high-class specialist is to-day recognized, comparatively well-paid and a strong demand exists for him. The engineers of the old school may say that managers and presidents of large industries, who necessarily have general duties, do not come from specialists. A modern engineer's answer is: "It must be true with the present world's attitude that more men can reach a measurable success in life by confining their endeavors along one particular line than by trying to cover several distinct fields. Also that it is good reasoning to assume that a man who can follow one branch in a large way may handle two or more with equal facility."

Operation and Management

Going back to the primitive engineer we find him equipped with a general technical knowledge. Then we next have the engineer with specialized technical training. In the beginning he was content to design and install plants and equipment. It was then realized that a reasonable function of the engineer was the operation of these installations efficiently. The public have been quick to appreciate this as a proper field for the engineer, and the result is the widespread interest in the art of management methods, efficiency engineering or whatever you may care to call it. And bringing our discussion closer home, we find a great many positions that are practically managerial and executive as relating to their duties in both the steam and electric railway industry occupied by men who came up through the engineering profession. Anyway, why should not certain engineers be successful in these positions? After all, in their work they are only applying the methods of design to that of management.

Financial Knowledge

A great many engineers will now appreciate the fact that it is necessary to gradually acquire at least a general knowledge of accounting and finance. How many times in the past has the profession been called on to take responsibility for the cost of work, much of which was not directly associated with the physical structure?

The Panama canal is a world-wide example of an improvement where the actual cost to execute the work was supposed to be in excess of anything anticipated by the engineer. A common figure of the cost of the Panama canal was $400,000,000. Now, as a matter of fact, according to the Canal Record, the real expenditure for this great work up to date is about $323,000,000. The cost of the actual construction of the canal amounted to only $204,000,000, or less than two-thirds of the actual expense. The remaining $110,000,000 went to civil administration, sanitation, payments to the French Canal Company, Republic of Panama, fortifications and financing.

In the early days it was a mistake of the engineer that he did not interest himself in anything but actual engineering details. It is easily understood how his success was very much hampered, when as a matter of fact any engineering project of improvement necessarily involved many of the phases that may be dumped into the general receptacle of overhead charges. It was due to the lack of development of the engineer along financial and accounting lines that we had misunderstandings about the proper valuation of public utilities. We might cite the recent nomination of Mr. F. A. Delano, engineer and railroad official to the Federal Reserve Board as an indication that the field of the engineer includes financing and accounting.

Engineers in Public Life

In the past the profession has principally served the corporation or private industry. We now find the technical man firmly intrenched with Federal, State and Municipal authorities. The large responsibilities based on detailed examinations and research of various commissions, utility boards and local governments, have opened up a practically new field for the engineer. At first he was content with being only a component part of this machine, acting as an assistant or statistician. The future will see the engineer more as an actual representative of these various controlling bodies, and playing just as an important role as the economist or lawyer.

Again, the day of permitting the topsy-turvy development of the American cities is fast waning. Marvellous results have already been obtained in Europe by systematic city planning and by comparatively simple means that have been originated by the engineer, and now there is hardly a city of importance in the world that has not considered, at least in a tentative way, city planning schemes with which the engineering profession is more or less identified.

Along the line of public affairs the engineering societies, and each individual engineer, have before them as citizens a plain duty that should not be overlooked. Time and time again we see unscrupulous politicians capitalizing erroneous technical knowledge. We have in public speeches and writings almost every day statements that engineers know are other than fact. The cries for 3-cent electric railway fares and municipal ownership are familiar themes along with other impossible theories, and the public is only too ready to subscribe off-hand to these fallacies. The engineer should not wait to be asked to refute, with a paper sword for defence, the theories that are going to harm the public at large. I am sure lawyers or doctors would not allow a false theory launched upon the public relating to their profession without a howl of disapproval.

It does not seem necessary to dwell further on the fact that we have a rapidly developing field for the technical man in public life. "The proof of the pudding is in the eating" and we now find that the engineer is being recognized and is playing important roles, as is illustrated by the appointment of Col. Goethels as Governor of the Canal Zone and Mr. Henry M. Waite as manager of the city of Dayton, Ohio.

Proper Training

Briefly, the enlarging field for the engineer now includes: first, the work of the specialist, illustrated by the bridge, valuation and foundation engineers; second, the engineer in administrative positions, such as the chief engineer of a steam road and the superintendent of equipment of electric railways; third, the engineer in managerial and executive positions, as the vice-president and general manager of electric railway companies, the general manager of water supply companies, and fourth, the engineer in public life, illustrated by the city manager.

We may readily see that the possibility of laying out a proper schedule of training to generally apply is well nigh nil, and certainly the task will not be attempted by the writer. Too much has been expected of a college curriculum. It may be improved upon, but it never did nor ever will produce a representative engineer. Personality and inherent worth are ever swaying the career, although you may be unconscious of it. Everyone knows as a general proposition, that a man with a strong, pleasing personality and a broad and honest viewpoint is going to get along much further and faster than a "crab" even if both have equal ability. It must be admitted that one of the failings of our present whole plan of special training or education is the lack of vocational guidance. The technical schools have come into any amount of criticism, primarily due to the fact that hundreds of students enlist without any real choice of a life work. Some of the men may study four or five years before it finally dawns upon them that the selection they have made is a grievous error, and it may then be too late to shift their position or they may be too proud to acknowledge their weakness. A tremendous economic waste is therefore going on all the time in our colleges.

Marketing Your Goods

Assuming that we have proper material to educate it is important to keep in mind that it is one thing to have knowledge and ability, but for success it is just as necessary to be able to market your goods. Only the inventive genius who is the exception can do very much on an individual basis. It has always appeared ridiculous to the writer that our colleges did not do more to meet some of these practical problems. How many college men can go into an office and make a favorable impression when applying for their first position, much less describe a simple engineering feat or express their own point of view in an impressive way, and if necessary defend their position against some "doubting Thomas". And the engineer should know something about practical accounting and financing, as every engineering project is impossible without them.

In conclusion, it is plain that one man may not be fitted for all branches of the engineering profession, (possibly none) but still he may be successful in a particular phase of the work. We are in urgent need of proper vocational guidance. A process of elimination is necessary. Possibly a scheme similar to that of the Horner or Hamilton methods of rating employees would produce results. Whether the proper college course is a full academic one, followed by a specialized technical training alone, depends upon natural qualities, financial and other existing conditions. Whatever our present college education might be, most men will certainly benefit by getting a taste of practical labor, not in a college shop stocked with instructors, college-bred men and fat pocket books, but, by say a year's practical work on the same basis as the rank and file. The human sympathies and aspiring character of the man at the bench or in the ditch will give the so-called trained man a new and proper angle from which to view his future duties, trials and tribulations.

Lead wool for caulking flexible-joint pipe lines was tried unsuccessfully in the experimental work done in connection with the Narrows Siphon across New York Bay, according to Mr. T. H. Wiggin, senior designing engineer of the New York Board of Water Supply. In discussing the subject at a recent meeting of the American Society of Civil Engineers, Mr. Wiggin stated that in spite of repeated experiments the Board of Water Supply had found it impossible to get a joint suitably watertight without making it so rigid that it could not be turned. The time required for caulking with lead wool was also an important objection to its use.

The Swaying of Tall Buildings

THE city of Chicago, built as it is on sub-strata of clay, furnishes the most interesting study of the movement of buildings, and the greatest number and variety of examples. All of the early skyscrapers of that city were carried on floating foundations or on piles driven deep into the clay. These buildings without exception settled into the soil due to their weight, the distances they settled varying from three to over five inches. Many of these buildings, notably the Great Northern Hotel, are partially carried on jacks and periodically levelled up as settlements occur, then, after all subsidence has taken place, and the buildings have finally come to rest, the jacks are removed and the foundation walls filled in with masonry.

That is one of the movements of buildings, then, settlement; but settlement takes place only in those buildings erected on floating foundations. When the footings are extended down to bed rock, as all footings for present day buildings in Chicago are, the amount of settlement that takes place is nil and may be disregarded.

But even buildings with their footings carried to bed rock lean or are racked out of plumb, and the taller the buildings the more they are likely to lean, although the amount they are out of plumb is seldom enough to endanger the structure. Recently the Unity Building at Chicago was straightened, being considered "unsafe, but not dangerous," at thirty inches out of plumb: It is impossible to prevent the big buildings from leaning. Some of them are not straight when they are finished, but that does not impair their safety, and it is probably safe to say that every building in Chicago leans more or less. If they are on floating foundations they also settle gradually. But there is still another movement of buildings, and the most interesting of them all to consider. For instance, the Eiffel Tower swings perceptibly in the wind, and even stone shafts like those of the Bunker Hill and Washington monuments move several inches at the top. The side that is towards the sun expands during the day more than the side in shadow. An interesting device has been employed to show the movement of the dome of the Capitol at Washington. A wire was hung from the middle of the dome inside the building down to the floor of the rotunda, and on the lower end of the wire was hung a 25-pound plumb bob. In the lower point of the weight was inserted a lead pencil, the point of which just touched the floor. A large sheet of paper was spread out beneath it. As the dome moved, it dragged the pencil over the paper every day. The mark made was in the form of an ellipse six inches long. The dome would start moving in the morning as soon as the rays of the sun began to act upon it; and slowly, as the day advanced, the pencil would be dragged in a curve across the paper until sundown, when a reaction would take place and the pencil would move back to its starting point. But it would not go back over its own pencilled track, for the cool air of night would cause the dome to contract as much on the one side as the sun had made it expand on the other, and so the pencil would form the other half of the ellipse, getting back to the original point all ready to start out again by sunrise.

In the three movements affecting tall and heavy buildings we have, then, particularly in the expansion and contraction movement which is of daily occurrence, and which affects skyscraper buildings as well as all other tall structures, a condition which must be taken into consideration when planning the buildings. Lines of steam pipes, stocks o fdraining pipes, lengths of water pipes, vacuum cleaning pipes, refrigeration system pipes, electric wire conduits and the various networks of tubing which cross and criss cross inside of a building will naturally be more or less affected by the movements of the building; and if long life is expected of these various systems of piping, they must be so installed that they can "give" under the movements of the building without damage to the piping, and sufficient to compensate for the change of position.

Besides pointing out the necessity for flexibility for the piping systems in tall buildings, the movement of buildings shows how desirable it is to have solid foundations the footings of which extend down to bed rock. Floating foundations are all right for some kinds of buildings, but for the skyscraper type there is nothing so good as the solid rock of old Mother Earth

Repair Work on the Edison Concrete Buildings

THE repair work on the reinforced concrete buildings of the Edison plant at West Orange, N.J., seriously damaged by the fire of last month, is progressing very rapidly, according to the Engineering News, to whom we are indebted for our information. Especial progress is being made in Building 24, which is being put into immediate service under the direction of T. L. Condron, consulting engineer. This building, which housed the phonograph cylinders, was one of those most seriously affected by the fire. In regard to this building, Mr. Condron reported to Mr. Edison as follows:

> The effects of the fire have been most disastrous to the four bays at the west end, so that in my opinion it is advisable to tear down at least the three upper storeys of these bays. This represents about one-seventh of the entire floor area of the building. It will probably be possible to save the first and second storeys of these bays, using the third floor here as a temporary roof, rebuilding the three upper storeys later. The collapse of one of the interior third storey columns of this extension caused ruptures and serious strains in the surrounding panels. Where columns have been cracked diagonally across their sections, they should be entirely removed and replaced.
>
> With reference to the columns that have only been injured on the surface and for a distance of 3 or 4 in., but the centres of which are still in good condition, I recommend that they be repaired as indicated (in Fig. 1). This involves the removing of all loose concrete, leaving in place the solid centre. I estimate that in the case of the 24-in. square columns, which have an original area of 567 sq. in., there will still remain at least 350 sq. in. of ground concrete.

As shown in Fig. 1, these columns are being repaired by casing the remaining solid core in a circular section of concrete reinforced with vertical rods and with spirals wrapped around the old core. In effect the method is as follows: A fairly close-spaced spiral of 5/16-in. rods is wrapped around the core, fitting into notches cut in vertical angles used as spacers, and additionally reinforced with eight ⅝-in. round rods. It is then incased in a cylindrical steel form reaching to within about 12 in. of the bottom of the girders, and concrete is poured to form the column. The remaining height of the column is then put in with the cement gun.

The wall columns, whose sections were very seriously affected, are being replaced by entirely new rodded and hooped columns, and those wall columns which were only partly damaged are being sledged and picked down to the solid concrete and wrapped with wire mesh, on which the concrete-mortar is plastered with the cement gun to make the finished required section.

The floor-beams and girders in this building were somewhat more seriously affected than was at first thought. In regard to these beams Mr. Condron's report to Mr. Edison reads as follows:

> I am informed by the designer and builder, Mr. H. I. Moyer, that the floors were designed to carry live loads of 200 lbs. per sq. ft., and that the columns and footings were proportioned accordingly. I find that in the construction of the floors, the floor slabs were not poured at the same time as the floor-beams and girders, with the result that the slabs and beams are not integral. Likewise the slabs and girders are not integral. Also the beam and girder reinforcements, instead of being bent up to near the top of the slab over at the supports, was left at least 6 in. below the top of the slab. Separation of slabs and beams were observed before the fire, and diagonal and vertical cracks had developed in these beams, although the floors were subjected to very light loading. Therefore until these floor-beams are substantially strengthened they cannot support safely the assumed floor load, because the slabs do not form the consistent compression flange as assumed in their design. The present strength of these floor-beams is indeterminate, but in my opinion where the slabs and beams are thus separated the floor loads should be limited to a uniform load not exceeding 60 lb. per sq. ft.
>
> The slabs themselves have sufficient strength in sections to safely carry the floor loads to the beams; but the beams, which extend from column to column and from centhe of girder to centre of girder, are the weakest feature of the floor construction.

For the repair of these beams the design shown in Fig. 2 is to be undertaken. In brief, it consists of bolting, by means of expansion bolts, two 4 x 4 x ⅜-in. angles to the underside of the floor slab and by through bolts to the beam, to attach through these angles and around the bottom of the sound concrete in the beam a continuous wire mesh reinforcement, and then to plaster with a cement gun sufficient concrete to form a square beam section. It is intended that all loose and cracked concrete be carefully removed from the beams, exposing at least the lower layer of the reinforced bars at the bottom. In some few cases both the lower and upper layers of these reinforced bars will necessarily be exposed. The sides of the beams are roughened with sandblast. It may be noted in passing that the stirrups in such beams as are exposed are not continuous U-loops, but are merely L-shaped bars descending from somewhere in or near the floor slab to the bottom of the beam, where the L-shaped bars on either side of the beam lap, as shown in Fig. 2.

The floor in Building 24 was a wooden floor on cinder fill and wooden sleepers. This was practically all destroyed by the fire, and a new floor consisting of a cement-mortar finish on the concrete of the slab is being placed. Steel sash and wire-glass have already been placed in all the usable windows, and fires are now going inside the building so as to aid the setting of the concrete in the prevailing cold weather.

In other parts of the plant reconstruction work is proceeding not quite so rapidly as in Building 24, which was required for immediate manufacturing purposes. In Building 11, which contained the packing-case room and in the first floor of which the columns were so seriously affected by the fire, reconstruction work shows that the destruction of the concrete of the columns was practically limited to the corners through the reinforcing rods. When the broken concrete is removed a fairly uniform circular core of sound concrete with its circumference just inside the reinforcing bars is left. It is thought that the reinforcing of these columns will be conducted in the same manner as has already been done in Building 24. That portion of Building 11 which collapsed is now being taken down by blasting and a gas torch. The office building, which was the least damaged of the reinforced-concrete buildings subjected to the fire, is now practically all in service, the new steel sash or wire-glass windows having been placed. The structure itself was very slightly damaged.

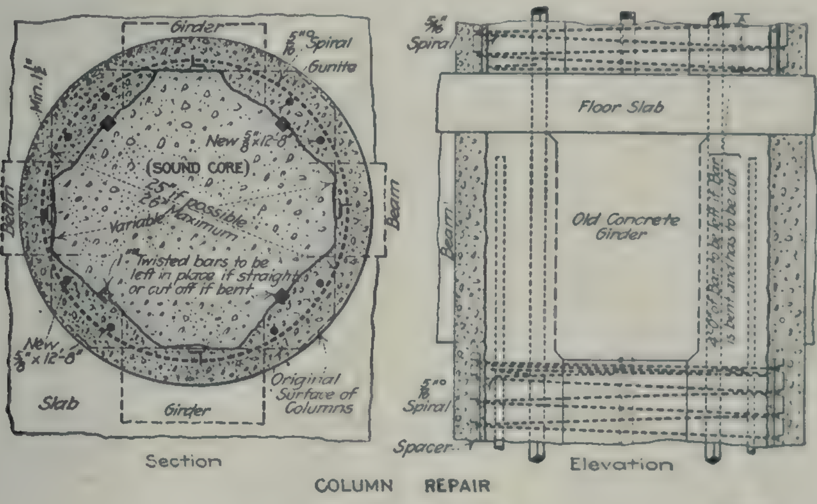


Fig. 1—Repair of damaged columns in building 24 at the Edison plant.

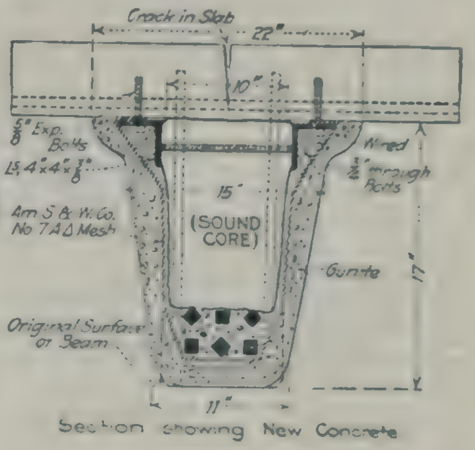
Nearly 1,000 miles of new railways were put into operation in the province of Alberta during 1914. The total mileage is now 4,250, it having doubled since December 31, 1911.

The space available in the lower portions of five reinforced-concrete chimneys completed recently for the Havana Railway, Light & Power Company, Havana, Cuba, has been utilized for storage rooms. As all chimneys are located inside the power house to economize on space two storage rooms were provided in each chimney. At an elevation 18 ft. above the top of the foundation a floor was placed and the chimney was provided with a doorway. Another floor was built giving 36 ft. above the top of the foundation another storage room. The outside diameter of the chimneys at the base is 20 ft. 6½ in. and the wall thickness is 19 in.

Cost of Building Construction

It has been said that the cost of building is about equally divided between wages paid to the laborers and artisans who construct the building and the cost of the raw or manufactured materials entering into it, says a writer in a recent issue of the American Architect. This is perhaps, says our contemporary, as true as such generalities usually are, but will, of course, vary according to the nature of construction. For instance, the cost of imported stone or marble will be greater than the cost of setting it, while on the other hand, the cost of the materials entering into a medium or low-grade concrete will ordinarily be less than the labor of constructing the wooden forms, mixing the materials, and placing the concrete.

Assuming, therefore, that labor and material contribute about equally to the cost of building, which is generally admitted to be increasing, it is interesting to investigate the relative increase in the cost of each in the last few years. Reports have been received from Building Exchanges in twenty-two industrial centres giving the rate of wages per hour being paid July 1st, 1914, in the principal building trades, as well as to hod-carriers and laborers. The average increase since 1907 for each trade in each group of cities is also given for purposes of comparison.



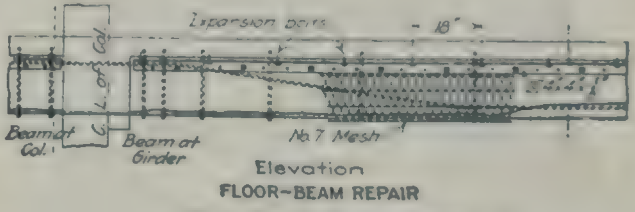


Fig. 2 Repair of damaged girders.

These averages indicate that, for the cities listed, the greatest increase in wages of all trades has been gained in the South Central States, with an average increase of about 22 per cent.; next come the North Atlantic group, with an average increase of 17 per cent.; the North Central group, with an average of 16.4 per cent; the South Atlantic group, with an increase of 8½ per cent.; and, last of all, the Western States, where the average increase for all building trades appears to be but 3 per cent. in seven years. It is to be noticed, however, that wages in this group are already about as high as those prevailing elsewhere, with the possible exception of the North Central States.

The lowest wages now paid in any group, as shown by the cities listed, are in the South Atlantic group, where, as stated, an increase of only 8½ per cent. has been made in seven years. Possibly the explanation for these relatively low wages lies in the existence of a very large unskilled negro population. The wages of hod-carriers and laborers in these States are but a fraction of those prevailing in Northern and Western States.

Among the various trades given, the painters have enjoyed the greatest increase throughout the country as a whole, with the structural-iron setters and carpenters following as close seconds. With striking uniformity the bricklayers and plasterers are paid the highest wages per hour.

Just what effect the percentage of non-employment may have on the rate of wages cannot be definitely determined, for in most of the larger cities the trades are unionized and prices for such labor do not fluctuate in accordance with the "law" of supply and demand. For example, in 1906, an average of 9 per cent. of the members of certain New York unions were idle; in 1907, this increased to 16 per cent., and in 1908, to 29 per cent. In the three subsequent years the percentage of idleness was about 19, being, on account of the greater number reporting, numerically more than twice as many idle artisans as in 1906; yet during those five years wages were increasing. Statistics collected by the Bureau of Labor at Washington, D.C., show that in December, 1910, building metals and implements cost 28.5 per cent. more than the average during 1890 to 1899. At the same time the cost had increased 2.5 per cent. since 1908 and 3 per cent. since 1909. In December, 1910, lumber and building materials (other than structural metals) cost 53.2 per cent. more than the average during 1890 to 1899, and 15.1 per cent. more than in 1908, and 10 per cent. more than in 1909. Prices in effect since 1910, for proper comparison with the above figures, are not available. It is certain, however, that most building lumber has been steadily advancing in price largely on account of the diminishing ready supply. Other materials, with the possible exception of structural steel, which is widely fluctuating, may fairly be assumed to have increased in cost in proportion to the generally increased wages paid for its manufacture.

It is not the province of this article to enter into a discussion of the reasons for universally rising prices. It is but fair, however, to remind those who criticize the artisans for continually demanding increased wages that these wages represent to the worker not merely dollars but purchasing power, and as the purchasing power of the dollar decreases through rising prices he quite naturally feels the need of more dollars.

There seems to be but one way for the architect to cope in any measure with the increased cost of labor and building materials, and that way lies through increased efficiency of design. To-day we are designing our structural steel, for example, more economically than a few years ago. To-day we avoid the cost of the very heavy masonry walls which would necessarily have been built a few years ago by substituting an economical steel frame construction with thin curtain walls of masonry. We have by no means exhausted other sources of economy, and in the face of rising costs on every hand, when investors are more and more demanding economy in building construction, it is but reasonable that they should seek the assistance of the architect who can produce the desired results at the least net cost.

Large New Plant for Western Canada Cordage Company, Limited, at Calgary

(Staff Article)

LAST November construction was commenced on a large industrial plant for the Western Canada Cordage Company, Limited, of Calgary, who manufacture binder twine and rope, and employ about 360 persons when operating at full capacity. It was determined by the promoters that Calgary would be the most suitable location for such a factory, since the raw materials would be brought in from the Phillippines and Calgary is three thousand miles nearer that source than the nearest competitive mill in Canada, at the same time being in the heart of the market. The undertaking is being financed largely by New England capital, through the sale of bonds. The plant will be located in Manchester Subdivision, owned by the City of Calgary, and will involve an outlay of $250,000. It will have an ultimate capacity of about 6,000 tons of binder twine and 2,000 tons of rope, yearly.

The group of buildings will be erected on a plot of ground comprising some 6½ acres, adjoining the Canadian Pacific Railway, Macleod Branch, from which a siding will be provided. There will be an office building, 30 ft. by 60 ft.; a jute mill, 161 ft. by 401 ft.; a machine, pattern and blacksmith shop, 160 by approximately 35 ft.; and fibre and storage warehouses 81 ft. and 101 ft. wide, respectively, and 161 ft. long. Preliminary designs were made for both reinforced concrete and for mill construction, but the approach of cold weather and the necessity for rapid action determined the adoption of mill construction. The material throughout will be of slow-burning mill construction inside, with brick and hollow tile walls. All the buildings will be subdivided by fire walls of tile construction. The largest building, the jute mill, has a total length of 401 feet, being 161 feet wide, and is divided into three sections by fire walls. The roof of this building, as well as that of the shops, will be of sawtooth construction. Columns in this building will be spaced 20 feet each way. In the basement there will be a steam heating plant, with coal storage, and three oil tanks. The tanks have a capacity of 5,000 gallons each and have reinforced concrete walls, waterproofed, with 4-inch vitrified brick lining. The mill will have a daily output of 4,000 pounds per ten-hour day.

The exterior walls are carried on concrete footings and will have brick piers with hollow tile curtain walls except where heavy firedoors are to be hung, when solid brick walls will be used. The roofs will consist of patented roofing laid on 3-in. T. & G. planks. Ample toilet facilities will be provided.

On either side of the mill are the warehouses, the raw fibre coming into the south end of the mill from the fibre warehouse, and being routed north until it reaches the storage warehouse, ready for shipment. Covered walks join the warehouses and the mill and there are covered shipping and receiving platforms along the tracks.

The estimated cost of the group of buildings is $125,000. Mr. A. W. Knowles is the Managing Director. Mr. Charles Hay, of Calgary, is the architect.

Substructure of the Trent River Bridge

Features of Concrete Pedestals for Steel Towers and of Wooden Abutments Built to Avoid Retaining Walls in Fresh Banks

A single-track plate-girder structure spans the Trent River on the new line of the Canadian Pacific Railway east of Toronto known as the Campbellford, Lake Ontario & Western Railway. At each end of the bridge there are high embankments and to avoid the use of solid retaining walls on fresh banks the abutments are wooden skeletons that permit the slope of the fill to pass through them and extend nearly to the bottom of the first tower. The remainder of the substructure consists of separate concrete pedestals for the tower columns. These are typical of the construction adopted for similar conditions on this line and are provided with long anchor bolts arranged to permit initial displacement to provide for erection adjustment.

The abutments are three-bent framed wooden towers seated on sills bearing on the levelled surface of the rock fill, and are made chiefly of 12 x 12-in. timbers and 3 x 10-in. diagonal bracing. The vertical and batter posts are gained into the caps and sills, and the track is carried across the top of the tower on six 10 x 18-in. stringers. A transverse wooden bulkhead wall about 3 ft. deep across the top of the shore bents retains the ballast and the upper part of the fill, while below its lower edge the earth slopes unimpeded through the tower at an angle of about 1½:1.

Cost of Wooden Abutments

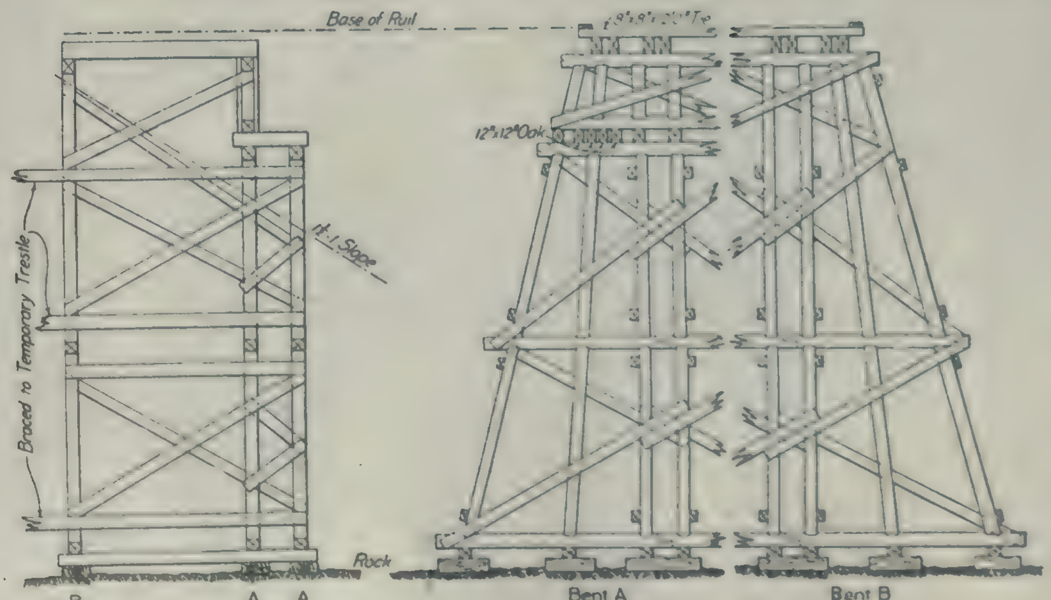
A platform of 12 x 12-in. longitudinals on the tops of the two shore bents receives the bearing for the plate-girder span and also supports a pony bent under the ends of the wooden track stringers. The abutments contain about 48,000 ft. b.m. of timber, detailed in accordance with the standard plans for high trestles. Their estimated cost is $960 each, as compared with the estimated cost of $2,500 for concrete structures of the cantilever wing type used for the Dixie Creek tube. The assumed life is from eight to ten years.

The pedestals for the tower columns have footings extending from low-water level, or from the surface of the ground, to solid rock. They support battered shafts extending just above high-water level, or above the surface of the ground. The tops are 6 ft. square and the footings are also square except for the upstream piers located in the river, which are extended by right-angle cutwaters as shown by dotted lines in the plan.

Each pedestal was provided with two vertical 2-in. anchor rods set in holes about 5½ ft. deep cored out of the concrete. These holes were 6 in. square at the top and 8 in. square at the bottom and were drained by a 3-in. inclined pipe. The square top was enlarged by a 6 x 6-in. funnel-like extension on one side to receive the grout which was poured in to a depth of about 2½ ft. when the anchor bolts were set. This left about 4 ft. of the upper end of the bolt free to be moved in any direction in order to match the hole in the column base, and also permitted the latter to be set in exactly the required position, after which the holes were grouted full, fixing the bolts against further displacement. Care was taken to exclude moisture from the upper part of the holes before the latter were finally grouted.

The work was designed and constructed under the direction of Mr. P. B. Motley, bridge engineer of the Canadian Pacific Railway.—Engineering Record.

Mr. Duncan McCormick, K.C., is engaged on an arbitration between the General Contractors' Association of Montreal, and Carpenters' Union, the latter having claimed an advance in wages.



Framing of wooden abutment used on Trent River bridge.

Foundations—The Main Factor in All Road Work[*]

By J. A. Johnston[†]

WHILE vast sums are being spent on roads, the work to be done is so enormous that the problem can only be solved by true economy. It is not a question of what material possesses theoretical advantages over another, but what will give us the most for our money—not merely the most roads, for if your roads are not properly built added mileage means added burden of maintenance, while on the other hand, if your first cost is more than conditions warrant, the interest on the investment may exceed the maintenance on a poor road. Of course, the first problem in road-building, in its broad meaning, is the location and gradient, but in the more narrow acceptance of the term road-building (meaning the travelled surface) the main factor is the foundation.

What to Use for Foundations:—where, how and when to use materials, and in what quantity,—is the science of road building. Many men have attained enviable reputations as road builders, based mainly on the fact that their work was all done in a locality which was blessed by nature with favorable soil conditions.

Massachusetts Practice

In our earlier work in Massachusetts, it was our practise to use foundations only in such locations as were unquestionably bad, and to take a chance on places regarding which we were in doubt. We believed it was cheaper to later strengthen the weak places than to use extra material that might not be necessary. Under conditions then existing with comparatively light horse-drawn traffic and with mainly gravel and water-bound macadam surfaces, this "take-a-chance" policy seemed a reasonable one, but no one could predict the future developments, and I doubt if we have actually saved any money by such attempts at economy.

Many road materials have been unjustly condemned when the real fault lay in the foundation and not in the surface material. There are many companies advertising their road materials as the final solution of the road problem, when, as a matter of fact, their specialties are merely surfacing propositions, many of which would give excellent results if used over a proper base but are far from being the whole road, as one might infer from their claims.

Surfacing is secondary to foundations. We have taken old, worn-out macadam roads, rejuvenated them with a bitumenized surface at a total cost of 10c per square yard; maintained them in excellent condition for four years at an annual cost of one-tenth cent per mile per vehicle, or about 1.4c per square yard. On the other hand, we have all seen roads where the surfaces alone cost from $1.50 to larger sums per square yard for 2-in. of bitumenized material, which have failed and gone to utter ruin in a very few years, and not because the traffic conditions were so severe, nor the surfacing material poor, but solely because they were built without a proper base under them.

The statement has many times been made that a waterproof surface requires little or no foundation, because no water can get through it to the soil beneath and so the base is kept dry. Many cases might be cited to show the fallacy of this belief. A little consideration of the capillary action of the soil which draws water from the sides of the road and under ground sources (as well as the water that will seep through the soil from higher points), will show that a waterproof surface is not sufficient without a proper base. It must be understood that each road is a problem in itself, and no standard treatment can be devised that will fit all conditions. There are many factors entering into the problem; soil, drainage, traffic, available material,—all should be considered.

In some localities good gravel can be had at a low cost, but there the many places where good gravel would have to be hauled many miles, and the cost would be prohibitive. In other places stone is abundant and cheap, while in others there seems to be no material fit for foundation purposes and all must be shipped in.

It is true that if you can obtain the right kind of gravel it makes an excellent foundation, but to give the best results it should be absolutely free from clay, loam or silt, and rather sandy. For instance, on such a base we have built macadam roads with only three inches of broken stone. There were a few soft spots in the spring where pockets of loamy gravel were found, but these were taken out when they developed, and one such road, which carried a considerable traffic on the edge of a flourishing Massachusetts village, was kept in excellent condition at a low cost for maintenance, for twelve years before it was resurfaced. In another place we built a section of road over a very soft bottom (practically quicksand) by first placing a bed of gravel 18 inches deep, and over that 6 inches of macadam. This road has been built sixteen years and has given no trouble. On the other hand, we have many miles of road built on gravel bases 6, 12 and in some cases 18 inches deep, that soften up and rut badly in the spring when the frost is coming out. It is our practice to carefully locate all soft spots in the spring, so that when funds are available for re-building such roads we may remedy the defect without guesswork.

Most gravel contains enough silt loam or clay to so draw moisture by capillary attraction that the frost will work in it and, of course, when the frost crystals thaw, it leaves the material porous, spongy and wet. This condition is aggravated by the rolling wheels passing over the surface and the tamping action of horses' hoofs which all tend to puddle it just as a tamper puddles concrete, drawing the moisture from below. Such a result unless extreme may not be serious if your road surface is of gravel or even water-bound macadam, for such surfaces are easily and cheaply repaired, but if the road surface is a high cost bituminous mixture it may be ruined, and you cannot afford to take such chances. It should, however, be borne in mind that a road may stand two or three years over a poor bottom with little apparent trouble but almost entirely go to pieces the third or fourth year. This fact has caused a great deal of trouble; for the inexperienced man, finding that a road stands all right the first year and assuming that it will continue to do so, proceeds with the same type of construction under similar conditions until the first fails and the whole road is ruined.

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[*] Paper presented at the annual meeting of the American Road Builders' Association held in Chicago last month.

[†] Division Engineer, Massachusetts Highway Commission. (See note in personal column of this issue, (Page 103).

Gravel alone cannot safely be trusted for foundation, and should never be used under a high cost surfacing except as a sub-base under stone foundation or concrete.

In our earlier work we depended largely on side drains built 3.5 ft. deep at the edges of the macadam. A 5-in. pipe was placed in the lower part of the trench and the drain filled with small stone fragments. Our theory was that these drains would dry out the sub-grade and keep the road surface firm. We built miles of these drains but they did not accomplish the desired results unless they were supplemented by a stone base under the macadam, and subsequent experience has shown that, except in rare cases, if the road is built over a proper stone foundation, the side drain is unnecessary.

One of John Macadam's theories was that no stone larger than you could hold in your mouth should be used in a road. Now I have a large mouth, but it won't hold as large a stone as experience has proven to give satisfactory results for foundations in Massachusetts.

In the last twenty years we have tried many methods of sub-soil drainage and many different forms of foundation. On some of our macadam roads with crushed stone 6 in. thick the road has, after one or two years, softened up badly in the spring. We tried the experiment of adding more crushed stone, without breaking up the old surface. In some cases we added 12 in. of new stone, making a total of 18 in. of stone fragments not exceeding 2½ in. in their largest diameter, and also built ground water drains each side of the macadam, and cross drains at 50 ft. intervals. The result was a failure; after two or three years the road broke up as badly as ever. As these results were obtained in several places, I think we have proven that crushed stone of small size is not satisfactory for foundation and is suitable only for surfacing. My theory is that the units are so small they have little bearing and having no cohesion when wet they sink readily into the mud. Regardless of theory the fact remains; and some of these stone particles have been found a foot or more below the original sub-grade.

It should also be borne in mind that the cost of the crushed stone is nearly three times that of the larger fragments. As some one may question this statement I will illustrate: Under sharp competition our average contract prices for field and wall stone (rolled and measured in place in the road) is about $1.00 per cu. yd. Our average price for crushed local stone (finished in place in the road) is about $1.50 per ton. A 15 ft. road 4 in. deep requires about 36.4 tons per 100 ft. exclusive of the dust used for binder; this is equal to 2 tons per cu. yd. or the crushed stone at $1.50 per ton equals $3.00 per cu. yd. It is, however, true that if the road were all crushed stone the unit price would be 25c to 50c less per cu. yd.

When we first began building our roads, if we found a place which seemed to need a stone foundation we used a telford paving 8 in. deep over 6 in. of gravel. The telford stones were set up on edge, the tops broken off to a true cross-section, and the joints wedged up and chinked. French drains 3.5 ft. deep were built at each edge of the road. These drains cost 35c to 50c per running foot. A year or two later the specification was changed and the telford was only 6 in. thick over 2 in. of gravel with the continued use of the side drain. The cost of this lighter telford was about the same as that of the thicker, and as the hours of labor were decreased and the price per day increased, we paid as high as 50c per sq. yd. for some of this telford. Later we abandoned the standard telford and adopted the "V" drain so called because it was roughly the shape of a broad "V" about 18 in. deep in the centre and 4 in. at the sides with stones not over 8 in. in their largest diameter. The cost of this foundation, for stone in place in the road, is from 75c to $1.00 per cu. yd. or about 25c to 33c per sq. yd. of road surface. This "V" drain is a combination of foundation and drain. The water flows in a channel in the centre of the road and is led off by bleeders to proper outlets. We built many miles of these drains on foundations only 10 ft. wide under macadam 15 ft. wide. This gave satisfaction in the earlier days as the traffic did not spread over more than 10 ft. except when passing another vehicle.

While this practise was satisfactory under the old conditions, it has now been discontinued because it is found that, as the high speed motor requires more room in passing, the whole width of the road is used. In fact, on our main roads we have been obliged to increase the width of the hardened surface from 15 ft. to 18 ft.

One objection to the "V" drain is the fact that owing to the extra depth of stone in the centre of the road the frost action is not as great at that point as at the edges where the stone is lighter and a considerable distortion is occasioned in the road surface. When the frost enters the ground, the lighter sides are raised more than the centre, with a resulting concave surface; later, when the frost is coming out, the sides thaw out more quickly, and there is an exaggerated camber. These extremes do little or no damage to a surface of gravel, macadam, or a soft bituminous matrix, but the more rigid forms of surfacing would be disintegrated.

Because of these inherent defects in the "V" drain, we have for several years been building stone foundation with a flat sub-grade. If the bottom is a soft clay or silty material which would work up into the voids of the stone foundation, we first place over it a bed of sandy gravel (when such material can be obtained), varying in thickness, as the conditions may require,—in some places 6 in., in others 12 in.,—and over this, stone fragments not exceeding 8 in. in their largest diameter. The depth of this stone foundation is never less than 8 in. in the centre and 4 in. on the edges; under extreme conditions we have used 18 in. in the centre and 14 in. on the edges. No attempt is made to place these stones as a paving, though some care is taken to lay the bottom stones on their broadest face to ensure a substantial bearing. This, I am aware, is contrary to the theory that a stone laid flat will tilt and cause trouble, and that the usual practise is to place telford stone on edge, but without discussing the matter further at this time, I can assure you we have built many miles in this manner without trouble. Small stones are thrown on top to close the surface crevices, the whole is then rolled with a steam roller until hard and firm. This thorough rolling we believe to be one reason for freedom from trouble due to tilting stone. If a bituminized surface is to be placed on the road the voids of the sub-base are filled with clean, sharp sand (we insist that this material shall be clean). This is rolled without wetting, and any surplus that remains on top of the base is swept off. This sand filling, however, is not an essential part of the base but is used only to prevent the loss of bitumen. Bleeders are used to drain the water from this foundation at proper outlets, and care is taken to so build these outlets as to avoid future clogging.

Foundations of this description have a fairly uniform frost action, appear to be preferable to the "V" drain and have been satisfactory. The costs, of course, vary with the conditions, running from about 15c per sq. yd. to 60c per sq. yd.

If a surface of wood, stone or brick blocks, or the more expensive types of asphalt is to be used, a concrete base is accepted as the best practice. It is open to some objection such as the delay incident to proper setting of the cement, and the fact that because of its rigidity it will crack under irregular frost action in mixed soils. We have all seen the result of this latter trouble in badly cracked pavements over concrete bases. On the other hand, the cracks can be largely guarded against by proper drainage, and it seldom cracks enough to cause disintegration, while if the cracks are due merely to frost action, they usually disappear when the frost is out of the ground. On this, as on other forms of foundation, the engineer's good sense and experience may save much unnecessary expense. I have seen a concrete base 1-2-4 mixture built 12 in. deep over a natural bed of excellent gravel, where only 4 in. was necessary. I have also seen 4 inches of concrete used over a bottom where fairly hard soil and soft muck holes alternated, and the engineer in charge of this work could not understand why his pavement cracked so badly the following spring.

The Engineer

(With apologies to Kipling)

By Robert T. Gebler in the Engineering News

You can rave about yer bloomin' Tommy Atkins on parade
And yer lady-like lieutenants on the Mall.
You can talk about your gunboats, yer rifles and yer camps
And yer heroes in the rain of leaden ball.
But the bloke I doffs me hat to
Didn't fight the sly mulatto
But he was in the battle just the same.
He's the bloke that planned yer bridges,
Built yer roads across the ridges,
To let Tommy Atkins march into the game.

With 'is transit or 'is level he would work to beat the devil—
The devil of a Kaffir, sir, I mean—
But the blokes as write the stories never pass 'im any glory
And they never throws 'im on the movie screen.
Out there 'e is a plannin'
And a river 'es a spannin'
As 'e gets the place in order fer the fair;
But the 'eathen start a shoutin;
They've fergotten all about 'im
And the history won't say that he was there!

Yer millionaires cut capers, get their pictures in the papers
And the public then begins a bloomin 'owl
'Bout the aqueducks 'en highways, the railroads and the byways
An' big jobs like the Panama Canal.
But as I've often read it—
The bloke who gets the credit
Is not the dusty khaki'd engineer;
But the guys wot 'ave the shillins
Get in first on all the killins',
Of the lad who turned the trick we never 'ear.

So I think when I am ridin down to Dover, or a glidin
In a taxi 'cross the bridge in Lunnon town.
Of the lads who built the town, sir, and the sewers under groun' sir.
The sea wall and Suez and did 'em brown.
But thye never sings 'is praise, sir
In the papers nowadays, sir;
'E never gets the credit that's 'is due.
But the fellers with the money
Wouldn't get the praise and honey
If the engineers wern't there to pull 'em through.

There is some difference of opinion as to whether it is better to build a fairly light base of strong concrete (4 in.) of 1-2-4 mixture or a heavier base (8in. or more) or a leaner mix 1-3-6, 1-4-8, or even a smaller proportion of cement. Conditions should decide this. In a mixed soil better results might be obtained by the greater depth of the lean mixture as there would be less frost action at the greater depth, and the increased depth of the concrete slab should more than offset the loss in tensile strength of the material.

Of course if it is planned to build a concrete road surface with the ultimate idea of surfacing it at some later time with bitumen or other material, there is no room for argument as to the use of a rich mixture as it is then necessary to so mix your concrete that it will withstand the abrasion of the traffic. If the bituminous surface is to be only a light one, it is still advisable to use the rich mixture as the shock of the passing traffic may cause enough surface disintegration to destroy the bond of the bitumen to the concrete.

Before closing I am tempted to refer to what appears to me an unwarrantable action on the part of some of those interested in bituminous surfacing processes, that of flooding the country with pamphlets attacking concrete roads. I do not recommend concrete roads exclusively, but I recognize their good points and recommend their use where I believe them best adapted to the conditions. It is certainly indisputable that under most conditions concrete makes an excellent foundation for a bituminous surface, so if, as its advocates claim, concrete road surfaces are failures, they can surely be used as bases for bituminous surfaces, and the more concrete roads that are built, the more foundation will be ready for bituminous surfaces.

In conclusion; gravel, stone and concrete all have their places. There is no sovereign remedy for all conditions; and I wish to emphasize the necessity of considering each road as a separate problem, in order to get the best value for the money expended.

Dustless street cleaners, operated on the combined vacuum and sweeper principle, are in use in a number of cities in the United States and Canada. It is claimed that their work is entirely satisfactory, and that after cleaning no sprinkling is necessary, as the dust has been thoroughly removed.

Merits of Reinforced Concrete Roofs

Steep Pitch Not Essential—Under Side May be Level With Great Resulting Economy—Some Valuable Tables

WHERE extensive roof construction is to be undertaken, the design, slab thickness pitch and reinforcement will necessarily be determined by an engineer or architect familiar with reinforced concrete construction. However, many cases will arise where readers of The Building Age will have occasion to roof small buildings, and this article is intended to supply such information as will enable a builder to employ reinforced concrete in the construction of roofs of reasonable size, in cases where the work is not of such size as to warrant the employment of an engineer or architect, and where recourse would otherwise have to be had to the makeshift of a temporary roofing material.

Even though other parts of a building are of fire-resisting construction, the roof is the most vulnerable part of the structure. Roofs are exposed to sparks and embers from without, and if made of combustible material, quickly blaze from interior fires; consequently, all buildings intended to resist fire should have fireproof roofs.

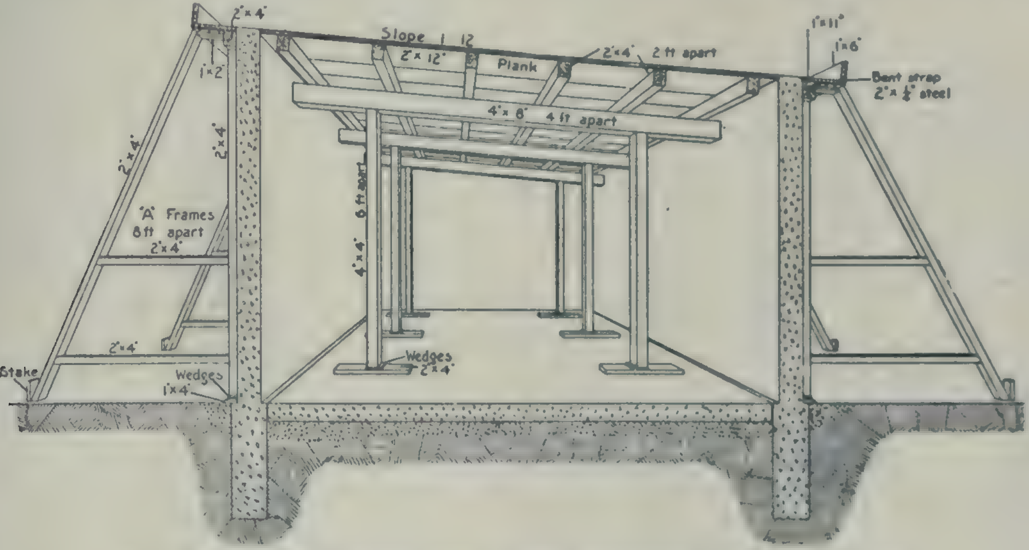

Fig. 1—Sectional elevation, showing "forms" in position for concreting a flat slab roof and eaves.

Many people have been deterred from using concrete roofs because of their supposed great cost, failing to remember that a concrete roof cannot blow away, requires no paint nor repairs, and will outlast any other material ordinarily used in building construction. When these factors are considered, the concrete roof will be found to be the cheapest in the long run.

Ordinary types of roofing material require a comparatively steep slope to resist driving rains. In contrast with these concrete roofs may be made comparatively flat, requiring a rise of only ¼ inch to the foot. If desired, the under side of the roof may be made level, the slope being obtained by varying the thickness of the roof slab; consequently, a great saving is effected in the amount of material, and, at the same time, the space underneath the roof is far more useful than when cut off by the sides of a sloping roof.

A suitable method of constructing forms of flat slab roofs is shown in Fig. 1. To insure a smooth ceiling, the face of the form underneath the concrete should be smoothly dressed, tongued and grooved lumber, although good results may be obtained with square edged planking, provided the edges are true so that no cracks will be open between the planks. Whitewash, or a mixture composed of equal parts of boiled linseed oil and kerosene, should be applied to the surface of the lumber that is to be in contact with the concrete. While 2-inch lumber is recommended for the face of the forms, lighter material may be used if sufficiently braced. All sizes shown in Fig. 1 are readily obtainable, being stock lengths and widths. Forms may be erected without nailing or fastening except where specially directed, as shown in the illustration. In this way the lumber may be kept in condition for future use for other purposes. Under the most favorable conditions in hot weather, forms should be left in place at least ten days, and longer in cold weather. Forms should never be removed while there is any doubt about the concrete having hardened sufficiently to support the load to be imposed upon it.

"Table A" shows the thickness of slab required for concrete roofs of various dimensions from 4 feet square up to 16 feet square.

"Table B" gives the amount of cement, sand and gravel or broken stone required for roofs of various sizes and thicknesses.

"Table C" shows the size and the placing of the reinforcing rods required.

Simple gable roofs for small concrete buildings should consist of a ridge beam and two slabs of reinforced concrete, as shown in Fig. 2.

"Table D" gives the size of ridge beam and specifies required reinforcing for roofs from 8 to 16 feet in length.

The ridge beam may be cast in place or in a mold

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* By Mr. Wm. M. Kinney, in the Building Age.

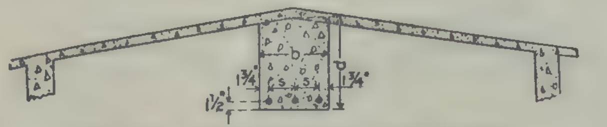

Fig. 2—Cross section of roof for small concrete building.

Table A

THICKNESS OF ROOF SLAB IN INCHES

Width in Feet Between Center Lines of Walls	LENGTH OF ROOF IN FEET BETWEEN CENTER LINES OF WALLS						
	4	6	[illegible]	10	12	14	16
	In.	In.	In.	In.	In.	In.	In.
4	2	2	2½	2½	2½	2½	2½
6		2½	2½	2½	3	3	[illegible]
8			3	3½	3½	3	4
10				3½	4	4½	4½
12					4	4½	5
14						5	5½
16							6

Load = Weight of roof + 50 pounds per square foot.

Table B

CEMENT, SAND AND STONE

Required for Concrete Slab Roofs. Proportions for concrete 1:2:3. (Each cubic yard of 1:2:3 concrete requires about 1.74 bbl. of cement, .52 cubic yards of sand and .77 cubic yards of stone.)

			WIDTH OF SLAB IN FEET (BETWEEN EAVES)						
			4	6	[illegible]	10	12	14	16
Sacks of Cement, 1 sack = 1 cu. ft.	Length of Roof in feet between eaves	4	0.7						
		6	1.0	2.0					
		8	1.7	2.6	4.2				
		10	2.2	3.3	6.1	7.6			
		12	2.6	4.7	7.3	10.4	12.5		
		14	3.0	5.5	8.5	13.7	16.4	21.2	
		16	3.5	6.2	10.1	14.4	20.8	26.7	33.3
Cu. ft. of sand	Length of Root in feet between eaves	4	1.4						
		6	2.1	3.9					
		8	3.4	5.2	8.3				
		10	4.3	6.5	12.1	15.2			
		12	5.2	9.4	14.6	20.8	25.0		
		14	6.1	10.9	17.0	27.3	32.8	42.5	
		16	6.9	12.5	20.2	28.8	41.6	53.4	66.6
Cu. ft. of sand	Length of Roof in feet between eaves	4	2.1						
		6	3.1	5.6					
		8	5.1	7.8	12.5				
		10	6.5	9.8	18.2	22.7			
		12	7.8	14.0	21.8	31.2	37.4		
		14	9.1	16.4	25.5	41.0	49.1	63.7	
		16	10.4	18.7	30.3	43.2	62.4	80.1	99.8

Table C

SPACING OF REINFORCING RODS IN INCHES

Width in Ft. Between Center Lines of Walls	LENGTH OF ROOF IN FEET BETWEEN CENTER LINES OF WALLS							Size Steel
	4	6	8	10	12	14	16	
	In.	In.	In.	In.	In.	In.	In.	
4	12 12	9½ 24	8 36	8 36	8 36	8 36	8 36	½ In. Rd. Rods
6		6 6	4½ 12	4 36	4 36	4 36	4 36	
8			11 11	9½ 22	9 36	7¾ 36	7½ 36	⅜ In. Rd. Rods
10				8¾ 8¾	7¾ 16	7 27	6½ 36	
12					6½ 6½	5¾ 12	5½ 16	
14						5¼ 5¼	4½ 8¾	
16							4 4	

NOTE.—Upper figures are for cross reinforcement; lower figures for long reinforcement.

Load = Weight of Roof — 50 pounds per square foot.

box on the ground. The latter method insures proper curing of the beam before it is subjected to loads. If the beam is cast in position, it can be made in a simple box mould supported on the same framing erected to carry the side slabs. In this case, concrete should be placed for the beams and slabs at the same time, casting them together as a monolith.

The proper size and spacing of reinforcing rods having been obtained from "Table C," the spacing of the rods should be marked off on the forms and then laid down and brought together at all intersections. The reinforcing should then be placed upon small blocks of wood or concrete in such a manner that the rods will be imbedded about one inch from the bottom of the roof slab. The effectiveness of the reinforcing is reduced if rods are placed any higher. In reinforcing gable roofs, the rods running at right angles to the ridge should extend from eave to eave continuously, not being broken off at the ridge. This binds the two sides of the roof together as one slab.

Concrete for roofs should be mixed in the proportion of one sack of Portland cement, 2 cu. ft. of clean, coarse sand, graded in size up to ¼ in., and 3 cu. ft. of hard, durable gravel or crushed stone, varying in size from ¼ in. up to 1 in. Aggregates both fine and coarse must be free from clay, loam or other matter which will tend to impair the strength or watertightness of the concrete. Bank-run gravel or crusher-run stone should never be used without screening and mixing in proper proportions. Wherever possible, mixing should be done by a batch mixer into which the materials are introduced in proper proportions, water added, and mixing continued by slowly revolving the drum for at least 45 seconds, or until thorough homogeneity of the concreting materials is obtained. Sufficient water should be used to form a quaky mixture, care being taken not to use so much water that the mass will flow to the lower side of the roof.

If mixing must be done by hand, it should be upon a watertight platform where the materials may be spread in layers and turned at least three times, or until of uniform color, after which water should be added and the mass again turned at least three times, or until very thoroughly mixed. A good concrete roof cannot be made from poorly mixed material. Where a comparatively flat concrete roof is to be placed on monolithic concrete walls, the walls may be brought to the proper height and squared off in the same manner as for a roof of other material. No reinforcing rods need extend from the walls into the roof but the concrete for the roof may be laid directly on top of the walls without grouting, thus leaving a joint which allows the roof to expand and contract freely. If the roof has a pitch exceeding 2 in. to the foot, it should be joined to the walls by extending the vertical reinforcing a foot above the top of the wall, and the top surface of the wall should in that case be left rough, drenched with water, and painted with grout immediately before placing the concrete for the roof. The roof should be finished in the same manner as a floor or sidewalk, using tools commonly employed for that purpose. One of the most important points in successfully constructing concrete roofs is to protect the concrete from the weather until thoroughly hardened. Newly-made roofs should be covered with wet straw or other material suitable for the retention of moisture, in order that the concrete may

Table D

Size of Ridge Beams for Gable Roofs

Length of Roof	8 Ft.	10 Ft.	12 Ft.	14 Ft.	16 Ft.
Breadth of Beam (b)	6 In.	8 In.	9 In.	10 In.	10 In.
Number of Rods	2	3	3	4	4
Spacing of Rods	2½ In.	2½ In.	2¼ In.	2 3/16 In.	2 5/16 In.

Width of Roof, Ft.	Depth of Beam, In.	Size Rods, In.	Depth of Beam, In.	Size Rods, In.	Depth of Beam, In.	Size Rods, In.	Depth of Beam, In.	Size Rods, In.	Depth of Beam, In.	Size Rods, In.
8	9½	[illegible]	10½	[illegible]	12	[illegible]	13½	[illegible]	16	[illegible]
10	10½	[illegible]	11½	[illegible]	13	[illegible]	15	[illegible]	17½	[illegible]
12	10½	[illegible]	12½	[illegible]	14	[illegible]	16	[illegible]	18½	[illegible]
14	10½	[illegible]	12½	[illegible]	15	[illegible]	17½	[illegible]	20½	[illegible]
16	10½	[illegible]	12½	[illegible]	15½	[illegible]	17¾	[illegible]	22	[illegible]

be protected from the action of sun, wind and rain for a period of at least two weeks.

Methods Used to Protect the Foundation of a Heavy Tower During Adjacent Subway Construction

The construction of subways often involves the use of special construction methods to protect the foundation of adjacent buildings. This is particularly true where the buildings are found on material which has a decided tendency to flow. During the construction of a portion of the Copley Square station of the Boylston Street subway west of Dartmouth Street, Boston, Mass., the work was made hazardous by the proximity of the high stone tower of the Old South Church, the foundations of which had, even before the subway construction was started, settled unequally in the soft silt and clay, causing the tower to lean an appreciable amount toward the street. The following article* describes the methods used to prevent further displacement during subway construction, the data upon which the article is based being taken from the discussion of a paper, "Boston Foundations," by Mr. L. B. Manley, in the Journal of the Boston Society of Civil Engineers.

The tower is a hollow stone shaft, 25 x 28 ft. in outside dimensions, with walls from 2.5 to 4 ft. thick, being connected on its north and east sides with the church building. At the belfry level, 120 ft. above the sidewalk, four corner turrets of brown sandstone are corbeled out and support the slate covered wooden roof whose peak is 231.6 ft. above the sidewalk, the peak being 246.5 ft. above the bottom of the foundations and 263 ft. above the bottom of the subway excavation. The footings are of granite, stepped out to 37 x 42.5 ft. They are laid in lime mortar, as is the remainder of the stone work, and rest directly on spruce piles, cut at 3.5 ft. above mean low water.

The total weight of the tower and its foundations is about 5,000 tons, which, if uniformly distributed on its base, would produce a load of 3.18 tons per square foot. The effect of the inclination of the tower is to shift the centre of loading toward the lowest corner of the base; and the inclination, combined with a wind pressure from the northeast of 30 lbs. per square foot, has been computed to give a maximum intensity of loading under the southwest corner of over 5 tons per square foot. The number and length of the supporting piles are not known, but if, as supposed, these piles are spaced 2.5 ft. on centres, this maximum loading would correspond to a load of 32.5 tons per pile.

The records show that shortly after the completion of the tower in 1875 a distinct inclination was observed which gradually increased until at the time the subway work was begun the tower leaned 2.5 ft. toward Boylston Street and 1.4 ft. toward Exeter Street, the resultant inclination being about 3 ft. toward its southwest corner, or in the direction of the subway location. This movement of the peak of the tower corresponds quite closely with the inequalities of grade in the stone water table extending around the base of the tower and along the church vestry and parsonage toward the west, and it indicates an unequal settlement of the tower considerably more than that of the neighboring buildings.

Character of Subsoil and Settlement of Same

The character of the soil below the foundations of the tower is shown by the borings to be silt and clay for a depth of 115 ft. The filled material extends from 20 to 22 ft. below the sidewalk, or about 6.5 ft. below the tops of the piles. Below this gravel fill there are 16 ft. of black silt resting on pockets of sand and gravel, and below the sand there are 102 ft. of clay, hard at its surface but very soft for the remainder of the depth. Below the clay there is a layer about 4 ft. thick of hardpan, resting on boulders or rock.

The great depth of silt and clay has also caused a general subsidence of the adjacent territory. The northwest corner of the Boston Public Library, which is across Boylston Street, has settled about 10 inches, and the curb between Clarendon Street and Fairfield Street has settled from 3 to 4 inches since 1904. In Dartmouth Street, where the depth of the silt layer is greatest, the curb at the southwest corner of Huntington Avenue has settled 0.46 ft. in 9 years; at Marlborough Street it has settled 1.54 ft. in 39 years; while a 6-ft. brick sewer in this street at Boylston Street was found to be 2 ft. lower than the grade at which it was set in 1870. It appears that the general subsidence in the vicinity of Copley Square has been progressing at the rate of nearly 5 inches in ten years.

Subway Construction and Methods Used

The Boylston Street subway, which is directly opposite the tower, consists of a two-track bore with a 20-ft. platform and a lobby for entrance stairways and ticket offices 30 x 55 ft. on the southerly side of the street (see Fig. 1). West of the lobby the two tracks and platform with side walls occupy a space 50 ft. wide. East of the tower the structure is widened to 70 ft., by the addition of the north platform, the roof of which is supported by three interior rows of columns. The whole station is constructed of reinforced concrete and rests on a heavy invert designed to assure a uniform bearing over its entire area. The bottom of the subway structure is 30 ft. below the surface and is 27 ft. from the foundations of the tower at its nearest point.

To encourage bidding on this section of the subway the transit commission assumed the responsibility for the safety of the tower under certain conditions, and in the exercise of this responsibility its chief engineer, Mr. E. S. Davis, prescribed the methods of construction to be followed at this location, which methods have been successfully carried out by the contractor.

The commission finally decided not to attempt the difficult engineering feat of underpinning the heavy tower of the Old South Church, but in place of such underpinning to take the greatest care to prevent any movement of the earth which would tend to reduce the bearing power of the piles supporting the tower. The method of operation adopted was, in brief, to construct the station in short transverse slices between lines of steel sheet piling previously driven, each slice on account of the possible upward movement of the bottom of the trench being completed before the excavation for the next had reached a depth of more than 10 ft. To prevent any inward movement of the steel sheeting during the construction of the slices a self-sustaining back-wall of reinforced concrete was first constructed in a narrow trench, the timbering being so arranged as to permit the completion of the back-wall without the removal of any braces. After this wall was completed the remaining core of earth was removed, and the entire section of the subway slice was constructed in one operation. As an additional precaution the ground between the steel sheeting and the tower was filled with large quantities of neat cement grout, with the object of solidifying the sand pockets, closing underground water courses, and making the sheeting watertight. These precautions were taken for a length of about 200 ft. on each side of the tower.

Throughout this length it was decided to rest the subway structure directly on the silt, without foundations, on account of the possilbe effect on the tower of the vibrations resulting from pile driving and of the risk of lowering the level of the ground water consequent upon sinking foundations to the hard clay. To prevent any lateral movement of the soil below the subway, a line of steel cut-off sheeting was driven below the invert at Dartmouth Street between the rows of side-wall sheeting, and the soil inside the cofferdam thus formed was grouted with cement both before and after the construction of the subway structure.

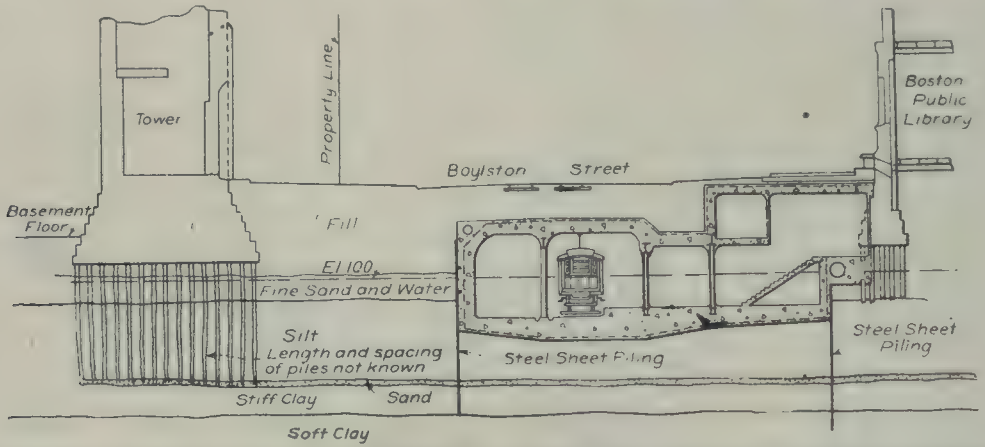

Fig. 1—Cross section showing foundation of tower of Old South Church, Boston, Mass., adjacent subway and character of subsoil at site.

The first operation was the driving of the steel sheeting around both sides of the subway and around the westerly side of the lobby in Dartmouth Street, in a trench about 12 ft. wide and 10 ft. deep. The sheeting used was of the arched web "Lackawanna" type, having a length of 35 ft. and weighing 35 lbs. per sq. ft. This was driven to the top of the subway structure by means of a "Union Iron Works" No. 1 hammer, operated by compressed air, the bottom of the piling extending into the clay a distance of 15 ft. below the bottom of the subway.

The grouting operations were next begun through 2-in. pipes, spaced 10 ft. apart next to the sheeting (except in front of the church tower, where they were 5 ft. apart), the pipes being driven to the clay by aid of a water jet. Through the open ends of these pipes neat cement grout under 90 lbs. pressure was forced into the ground until it would take no more; the pipe was then drawn up 4 ft. and the grouting was continued in successive operations until the surface was reached. The pressure of 90 lbs. per square inch proved so great as to lift the walks and even to start one of the interior columns of the church, and it was afterward reduced to 50 lbs. per square inch with satisfactory results.

After the grouting was completed, the slice construction was begun simultaneously at the east and west ends of the sheet piling. The first operation consisted of constructing the self-sustaining back-wall in narrow trenches next to the steel sheeting. On the south side of the subway this back-wall carried a 36-in. sewer and was 4 ft. thick; on the north side the wall was about 12 in. thick and was reinforced with steel rods laid horizontally. As each increment of this wall was carried about 5 ft. ahead of its corresponding slice it was supported against an inward movement by this amount of the earth core on its forward end and by the completed subway in the rear. As the earth between the back-walls was being excavated these wells were braced apart by a heavy trussed brace set at the top and forward ends to supplement the supporting power of the earth core. These supports were sufficient in most cases to sustain the back-wall during the excavation of the core and the placing of the main subway structure, but opposite the church tower ordinary timber braces were added for additional support, as the excavation was carried down.

After the excavation between the side walls was completed the concrete mat was immediately placed, and the floor and walls waterproofed. Then the invert was constructed; the side walls and structural steel were placed, and the roof was concreted and back-filled in the order named. This cycle of operations took about seven days for completion. As soon as the invert was constructed in slice No. 1 the excavation for the back-walls of slice No. 2 was begun, so that by the time the whole of the construction in slice No. 2 was completed the walls for the next slice were finished and the excavation of the core between them was begun.

The driving of sheet piling and the grouting of the soil were begun in the early summer of 1913, and the work of subway construction was started at both ends of the sheet piling during the last of June. After a short time spent in getting the organization to run smoothly, rapid progress was made, each slice, involving from 740 to 1,100 cu. yds. of excavation and from 178 to 200 cu. yds. of concrete, being completed in about seven days. After about 20 anxious weeks, during which time the tower was constantly under surveillance, the slices approached each other, and on Thanksgiving day, a day of special significance to all concerned in the work, the closing sluice was substantially completed.

In consequence of this work the total settlement of the tower at its lowest point was about one-half inch, and the increase of inclination at the belfry was slightly over 1 in. toward the street. During this time the use of the church was continued as usual, and no visible results of any magnitude are apparent in the building in consequence of the subway construction; in fact, on account of the solidification of the subsoil by means of the grouting it is supposed that the tower is now more stable than ever.

The Design of Concrete Pavements

THE purpose of this article is to call attention to the great necessity for the design of concrete pavements. Engineers have written numerous articles during the past few years concerning concrete pavements, laying stress on the importance of workmanship and materials, and in their endeavor to secure the best results by better workmanship and materials, they have almost ignored the more important item of design. Concrete is subject to certain laws and its behaviour has often been demonstrated, both in bridge and building construction.

What are these stresses which cause defects in concrete pavements? Where are they applied? How great are they? How may they be overcome? These questions may be briefly answered as follows:

Experience has demonstrated that expansion and contraction will cause transverse cracks in a pavement slab 6 inches thick, if the transverse joints are placed 50 feet apart, and that 25 or 30 feet is a safe distance to space them. Joints so spaced and protected by metal plates will free such a slab from any danger of transverse cracks due to contraction and expansion.

Other important stresses tending to produce cracks have been found to act vertically. Vertical motion is produced by the movement of the foundation upon absorbing moisture and again upon drying out. It is produced by the settlement of the sides of the roadbed, where they are less compact than the centre. This vertical movement is sufficient to cause the slab to act as a beam.

Hundreds of miles of concrete sidewalk and concrete pavement blocks have cracked longitudinally. They all show failure along the centre, or, in cases of extreme width, probably 10 feet out from the gutter line. This teaches but one thing, they were caused by forces acting vertically.

If a concrete sidewalk 4 feet long, 4 feet wide, and 4 inches thick does not crack longitudinally, and yet a block 4 feet long, 8 feet wide and 4 inches thick does crack longitudinally, what is the reason? If a thousand of such blocks crack longitudinally, what is the reason? It is not temperature, stress, contraction, expansion, unknown factor, dished or crowned sub-base, lack of reinforcement, but simply lack of strength in the slab to withstand the vertical movements of the foundation. In other words, for every width of slab, a definite thickness is required. This law is absolutely universal and every longitudinal crack in Wayne County, Michigan, Iowa, Illinois, or any other place, could have been prevented had the slabs been correctly designed.

We know the force of the vertical movements, for if they have caused uniform failures, and if failures have been prevented by a uniform reduction in width of slab to meet the thickness, we know all the necessary facts required to design correctly such a slab to withstand such vertical movements.

One reason why engineers have devoted so little time to concrete pavement design is that pavements have been a gradual growth from sidewalks and private driveways and few people have realized that a concrete slab for such purposes requires a design. Another reason is that the cement and steel people have designed either directly or indirectly many of the pavements and year after year they have proceeded with utter disregard for engineering principles.

The writer attended the National Conference on Concrete Roads, held last February in Chicago, and was in touch with many of the engineers there. It was observed that few came out with a frank admission of failure in design, and yet were more than anxious to learn a means of building concrete pavements without cracks, when it was intimated that such a thing was possible.

In Municipal Engineering for July, 1913, the Morse-Warren Engineering Company, of Carlinville, Ill., discussed the mathematics of concrete pavement design at some length, and later a table was prepared showing the thickness required for certain widths. During the past year, the correctness of design outlined therein has been demonstrated to numerous engineers. While it is true that in rare instances a pavement may be built on a porous foundation which will not be subject to vertical movements, it is poor economy to build any concrete pavement which is not designed to meet general conditions.

There are a few principles of design which, if followed, will produce at an economical cost, a concrete pavement free from cracks. They may be briefly outlined as follows:

1. Transverse and longitudinal cracks are caused by stresses which are greater than the strength of the concrete.

In other words, a slab of concrete, say 4 feet square and 6 inches thick, could withstand the forces of expansion and contraction and the vertical movements of the foundation, even though they should raise it several inches. It could stand the shock of travel and the action of the elements; in fact, such a slab would be free from defects.

That the economical slab is much greater in size than one 4 feet square has been demonstrated, and that there is a definite economical size of slab will be more fully explained in this article.

2. Vertical movements in the foundation cannot be economically prevented by additional rolling of the sub-grade nor by drainage.

This principle will be more fully understood when it is known that some of the strongest efforts to reduce cracking by putting the sub-grade in a permanent, immovable, and absolutely stable condition, free from

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* By W. D. P. Warren in Engineering and Contracting.

moisture, and free from any tendency toward future settlement, have failed entirely.

Take for instance the sub-grade at the edge of a pavement with a 6-inch tile laid 4 feet deep under that edge. In our section of the country, today, the entire sub-grade is dry. But suppose we have a season of rainy weather, with water covering the ground in many places. The 6-inch tile will act promptly and proceed to carry off the water, but at the same time the earth at the sides of the pavement will have absorbed moisture, causing it to swell, and the earth under the centre of the pavement absorbing less, will swell less, thereby causing unequal movement in the foundation and cracks in the pavement slab. This force acts in the opposite direction when the earth becomes drained at the sides more quickly than at the centre. The writer has observed slabs of concrete absolutely supported by a longitudinal ridge of earth, with the edges of the slab extending out into space, so to speak, and acting as a cantilever.

3. Reinforcement is a deception, as generally recommended.

Several scientific articles have been published during the last year, calling attention to the fact that any sufficient amount of reinforcement to prevent cracks in concrete pavements is prohibitive in cost; also it has been shown that the per cent. of reinforcement now generally recommended and used is only about one-tenth that ordinarly required.

Many engineers have built reinforced pavements after having had failures in plain concrete pavement construction, and have not taken into consideration the fact that they are getting better results in their later work, not because of reinforcement, but because of better workmanship and material.

A representative of one of the large steel industries after having inspected many miles of pavements, recently informed the writer that he had at last given up the theory that concrete pavements were to be saved from cracking by the use of reinforcement.

The vertical forces tending to destroy a concrete pavement act both upward and downward and yet some material men have the boldness to advertise that a reinforcement placed 2 inches below the top of a pavement will absolutely prevent cracks. If necessary 2 inches above the bottom but the point to be made here is that all such so-called reinforcement is not reinforcement at all; never was figured to be; and never can be anything but an extravagance and a deception.

4. For a given thickness of slab, with good workmanship and material, a definite width is required. The limit of width for a 6-inch slab, 1:1½:3 mix, is 10 to 12 feet, and everywhere you will find concrete pavements with longitudinal cracks where the width is any greater with that thickness.

5. It is economical to make a longitudinal joint in a pavement slab rather than increase the thickness where the width is increased.

If 6 inches is ample to give strength and durability sufficient for travel, it is poor economy to make the pavement any thicker simply to have a continuous beam or slab across the roadway.

Such a longitudinal joint should be protected by a metal plate now manufactured for that purpose. There is no patent on this plate.

6. A joint in a concrete pavement, properly protected and covered by a metal plate is not a weakness.

Engineers have in recent years thrown up their hands in horror at the idea of a joint down the centre of a concrete pavement. The fact is that today thousands of taxpayers are throwing up their hands in "holy horror" at the joints in their pavements, joints not planned and not protected by metal plates, which are unsightly, damaging and irregular ;and each year increasing the expense of maintenance. As suggested a year ago in one of our leading engineering magazines, longitudinal joints are not to be avoided; they are an absolute structural necessity.

7. A factor of safety should be allowed in design.

The methods of design herein outlined will produce a concrete pavement free from cracks, a pavement costing much less per mile than now recommended by engineers, and a pavement which contractors will with safety guarantee against cracking for a five-year period.

It is the belief of the writer that the design of concrete pavements and the proper protection of a longitudinal joint down the centre of the pavement should now receive the attention of the more expert, and that present knowledge of construction should be classified, with the thought in mind that concrete pavement design be reduced to a science.

To those who see the possibilities of the future, and to those who believe that there are defects today in the design of concrete pavements, is submitted the proposition: To design or not to design.

Road Work at Beaconsfield, Que.

At Beaconsfield, Quebec, a summer resort on Lake St. Louis, three miles of new roads were constructed last season. The new work consisted of one and one-half miles of asphalt macadam, one mile of Tarvia road, and one-half mile of water-bound macadam. The Tarvia and water-bound macadam roads were built by day labor.

The Mayor having given permission to quarry all stone free from his estate, the cost of erecting the crushing plant owned by the town, wages, coal, oil, repairs, quarrying and crushing the stone, was reduced to $0.49½ per ton.

A start was made on Kirkwood Avenue, where a gang of twenty-five men were put on, cutting brushwood, filling in old drains, and grading. The road is 60 ft. wide and 2,000 ft. long, with a roadbed 20 ft. wide, having shoulders 3 ft. wide and a ditch the whole length, three ft. wide and two ft. deep. The sub-grade was ploughed out 12 in. deep, after which it was watered and rolled. All depressions left by the roller were filled in with quarry waste, and rolled until an even surface was obtained. Upon this surface was laid a foundation 8 in. deep, which was rolled solid to grade. All voids were filled in with sand and stone grit from the quarry. The road was watered and rolled, after which 2-in. stone was rolled in until a compact bed 4 in. deep was obtained. Over this surface was flushed 1¼ gallons of Tarvia X to the square yard, covered with a layer of 1½-in. stone chips, and left twelve hours before the final rolling.

The cost of making this length of road worked out at $0.95 per square yard.

The work was done under the supervision of the Town Engineer, Mr. George Reakes.

The Canadian Car & Foundry Company, Limited, Montreal, have opened an office in London, Eng. They expect to obtain an order for war material from the allies, and at the present moment the firm is turning out about 1,600 shrapnel shells daily. The London office is in charge of the vice-president, Mr. Butler.

Problems Arising Out of the International Niagara Power Situation*

By Arthur V. White†

A complex situation exists along the Niagara River, more particularly in the vicinity of the Falls. Since the ratification of the Boundary Waters Treaty, a number of Bills relating to hydro-electric development on the Niagara River, have been presented to the United States Congress.

Smith Bill—Cline Bill

Two such Bills have been under special consideration by the Committee on Foreign Affairs. One of these was introduced by Representative Chas. B. Smith, of the State of New York, and the other by Representative Cyrus Cline, of Indiana, who is also Chairman of the Sub-Committee on Niagara legislation.

Of the various Bills introduced, the provisions of the two just mentioned are the more important, and if enacted into law, without being modified, will be of serious import to Canada. Such Bills have one very important aspect, namely, that if they are enacted into law they are of force in the United States, even though the Treaty relating to Boundary Waters should lapse.

There are two features which affect Canada more immediately and which are common both to the Smith Bill and the Cline Bill. These are: **the exportation of electricity from Canada to the United States**; and, second, **the quantity of water which will be permitted to be diverted from the Niagara River for power purposes.**

During 1914, it has been necessary, on several occasions, to prepare Memoranda dealing with these subjects, and some of the statements appearing in such Memoranda are here made use of.

Doctrine of Equal Benefits

Before proceeding with our brief survey there are one or two matters related to the legislation now pending at Washington, which should be borne in mind. One of these is what we may term the **Doctrine of Equal Benefits.**

When the International Waterways Commission has deliberated on behalf of Canada and the United States, upon such matters, the opinion has repeatedly been expressed, that the division of Boundary Waters and the benefits therefrom, should be based upon the doctrine of equality. It was represented that neither Canada nor the United States desired to be forced into circumstances which made for inequality of benefits without receiving adequate **quid pro quo.** Thus, with respect to electrical energy, one fundamental subject laid down for consideration by the Commission was:

> "The transmission of electric energy generated in Canada, to the United States, and vice versa."

The present International Joint Commission, in some of its opinions, has been pronounced in giving expression to this same principle, or doctrine, of equal rights and benefits.

A Question of Jurisdiction

One other point involves the question of extent of the jurisdiction of the International Joint Commission, with respect to certain diversions of water above the Falls. Both the Smith and the Cline Bill contain provisions which imply a raising of this question.

A careful reading of the Boundary Waters Treaty will show that the International Joint Commission have jurisdiction over the Lower Niagara River. It would, however, appear that the authors of the Bills above referred to, as well as certain other persons, assume that the Commission are without jurisdiction for certain diversions **above** the Falls.

The Subject of Plant Efficiency

This subject of jurisdiction may involve the right to utilize the additional 100 feet of head existent in the Lower Niagara River. And in this connection both the Smith Bill and the Cline Bill contain provisions relating to efficiency of plants; and to the possible enforced abandonment, at the order of the Secretary of War, of the present power developments at Niagara Falls on the United States side of the boundary, and the replacement of these plants by others utilizing the water under the combined head obtainable from the Falls, and the rapids of the lower River. This is an important subject, because, for one thing, companies in the United States—notably the Niagara Gorge Railway Company—appear to be seeking an opportunity to make diversions from the lower Niagara River. It would be profitable to consider to what extent either of the Bills would afford opportunity for companies to secure such rights of diversion and, in this connection, the remarks of the late Secretary of War, before the Committee on Foreign Affairs in February, 1913, are notable.

Expiration of Burton Act

Another point to be remembered, is that the Burton Act, which for years restricted both the diversion of water and the importation of electricity into the United States, expired about a year ago. The Burton Act provided for the granting of permits for diversion on the United States side, of 15,600 cubic feet of water per second. The Boundary Waters Treaty provides for an allotment to the United States of 20,000 cubic feet of water per second. Permits for the difference, 4,400 second-feet, have not yet been granted. This surplus water is coveted by the State of New York; by the existing power companies; and by other interests. A knowledge of this fact will throw light on certain phases of the legislation proposed in the Bills which are here a subject of comment.

The United States Fears that Canadian Markets May Absorb Electricity

An object avowedly sought to be attained by some of these measures, is **the importation into the United States of increased quantities of electrical energy generated in Canada.** It is abundantly evident that the motive prompting the **early** passing of such legislation is the fear that the longer the delay that occurs in actually receiving electrical energy from Canada, the less will be the amount that may be so received; because Canada, owing to her growing manufactures and demands, is rapidly absorbing the surplus energy which is coveted chiefly for the State of New York.

Consider some confirmatory testimony upon this matter: Lieutenant-Colonel J. C. Sanford, reporting on January 6th, 1913, upon the subject of Niagara power, to the Chief of Engineers, United States Army, states:

> "There is no question but that Niagara power will soon be utilized to the fullest extent allowed by governmental restrictions. If advantage of the power, generated in Canada, cannot be had on the American side, manufacturers will be attracted to Canada by this cheap power, and the industries of this country will suffer accordingly. The effect of present restrictions on the importation of power is becoming noticeable. . . .

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*Paper presented at the annual meeting of the Commission of Conservation held in Ottawa, January 20, 1914.

†Hydro-Electric Engineer with the Dominion Government.

> Manufacturers at present contracting for additional Niagara power must locate and are locating in Canada. It therefore seems advisable to permit immediately the importation of Niagara power to the fullest extent permissible under the law, and, other things being equal, to grant permission for its importation to the company or companies which will make the earliest use of such power."

The former Secretary of War, Honourable H. L. Stimson, before the Committee on Foreign Affairs, recently stated that:

> "The investigation which has been made by the Engineers indicates that Canada, if we do not take it, will use the entire amount that the Treaty permits in a very brief time, so that whatever effect any restrictions on importation would have, would not protect the falls for more than a very brief period, and it would result in giving to Canada, very possibly, a large number of industries which otherwise would be established on this side of the falls."

When Representative Chas. B. Smith was speaking on behalf of his Bill, he submitted, before the Committee on Foreign Affairs, a letter from a leading citizen of Buffalo, in which it is stated:

> "Every restriction on the importation of Canadian power should be at once removed. Electrical power is a **raw material and should be free."**

The Sub-Committee on Niagara Falls power, appointed by the Committee on Foreign Affairs, in their report on one of the Cline Bills, state that it had been urged for their attention:

> "That the Canadian companies were rapidly increasing their sales and would very soon take the full amount of water they were entitled to and United States ought to get what power it was able to **now."**

and they add:

> "If the advancement in the development of power on the Canadian side increases for another year or so—and it is not apparent to the Committee that it will not, then the Committee concluded that it was proper to take as large an amount as it could get for consumption in the villages, cities, factories and homes along our border."

Representative Chas. B .Smith, of the State of New York, in conversation, stated to me, that he favored no restriction on the importation of electricity, because if it was good for United States to have this commodity he thought it was advisable to get as much as possible, and permit it to come into the country without any restriction. This view of Mr. Smith is amply reflected in certain bills of his which provide for no restriction.

Market in United States for Electricity

In the State of New York there is a ready market for additional electrical energy. The **Opinion,** delivered on February 12th, 1914, by the Public Service Commission of the State of New York, states:

> "That there is a large shortage of electric power in Western New York with a strong demand for greater supply which is not being met by existing companies."

Again the **Opinion** states:

> "We are using all the power made on the New York side, and all that has been brought from Canada, and the demand for more power in Western New York is insistent and is being urged with great force."

It is also stated that Niagara Falls power produced in the United States is so far from supplying the needs of portions of the State of New York, that if the importation of power were prohibited it "would plainly amount to a great public calamity."

It is most definitely affirmed that there is present demand for additional electrical energy on the United States side of the boundary, and, in consequence of this market, strenuous efforts, especially during the last two years, have been made to secure as large an amount of power as possible from the Canadian side. By so doing vested interests may be created, and thus make it difficult, if not impossible, for Canada ever to use this power without the risk of serious international differences.

International Complications Possible

Canada, naturally, desires to avoid contributing to any circumstances which might have within them the possibility, later, of creating difficulty with any foreign nation, and especially any difficulty with the Republic on her southern border.

The chief danger lies, not with the peoples themselves, but with the aggressiveness of powerful United States' commercial interests whenever they fear their assets are jeopardized.

In the **Opinion** just rendered by the Public Service Commission of New York, the Commissioners state:

> "We have nothing before us but the suggestion that the Dominion of Canada may at some future time forbid this exportation. This Commission must assume that international relations affecting so important a subject as the means of continuing great industries which have grown up in reliance upon the use of this imported power, and as well the interests of the Canadian producing companies themselves have become fixed and subject only to such changes as will fully protect the great commercial and industrial interests and rights now served by this power brought from Canada. The time has long since passed when governments proceed ruthlessly from pure national rashness or anger to destroy the settled accepted commercial relations and formally vested rights of persons and corporations."

Elsewhere the Commissioners also state that:

> "In deciding these cases the Commission must assume that relations between Canada and the United States affecting the means of continuing great industries which have grown up in reliance upon the use of electric power imported from Canada, and as well the interests of the Canadian electric producing companies themselves, have become fixed and subject only to such changes as will protect the great commercial and industrial interests and rights now served by electric power brought from Canada; and particularly so as in these cases it appears that the percentage of export power to plant capacity is the same as has been and is allowed by Canada to other exporting electrical companies."

The Burton Act empowered the issuance of **revocable permits** for the transmission of additional electric power from Canada into the United States, and it may further be emphasized that the **Fluid Exportation Act** provides that licenses for the export of power from Canada are also revocable. What then is the real import of this remarkable statement by the Public Service Commission of the State of New York? It, in effect, proclaims that we, in New

York, need not be concerned about permits and licenses, revocable or otherwise; it states plainly that if we can get this electric energy from Canada into the United States, and have it distributed so that our citizens and industries become dependent upon it, then Canada could not hope to alter these conditions—for, in the words of the Commissioners, the conditions in the State would "have become fixed, and subject only to such changes as will protect the great commercial and industrial interests and rights now served by electric power brought from Canada—that is to say—as will protect "the great commercial and industrial interests and rights" in the United States.

Some years ago, when the relations of the United States with Canada were under discussion before the "Select Committee on Relations with Canada, of the United States Senate," Mr. Joseph Nimmo, Jr., addressed the Committee with respect to the possibility of Canada dealing with her transportation facilities in a manner such as, adversely, to affect interests in the United States using Canadian transportation, and stated that:

> "In the entire range of our Canadian relationship, from Halifax to Vancouver, the United States holds an over-powering advantage over Canada, and at every point. The suspension of the transit trade would be of comparatively small disadvantage to the United States, whereas it would be utterly disastrous to Canada . . . . . . It is high time for the people of this country to appreciate the fact that their National Government holds a preponderance of commercial power on this continent as absolute as the preponderance of its military power, and to demand that those who are charged with the affairs of government shall adopt such measures as shall prevent any interference by a foreign power with the course of the development of our domestic or foreign commerce."

Canada, in connection with the exportation of electricity, certainly does not desire to assist in the creating of any circumstances which would even tend to invite a possible carrying out of any such policy as is suggested by the language in the **Opinion** delivered by the Public Commission of the State of New York, or in the address, just quoted, as delivered at Washington before the Select Senate Committee on Relations with Canada.

When the diverse and powerful financial interests which are represented in these great Niagara developments are scrutinized, it will demonstrate the absolute necessity that we possess such a knowledge of the facts as will enable wise counsel respecting the adoption of administrative policy respecting the hydro-electric power appertaining to Niagara. To these matters the Commission of Conservation have devoted much study.

Other Water Problems Suggested

Questions connected with other waters such as with the St. John River in New Brunswick; Navigation and Power on the St. Lawrence; Transportation on the Great Lakes, and via the proposed Georgian Bay Canal; questions relating to diversion and power development on the St. Mary River, Lake Superior; or on the Fraser and the Columbia Rivers in British Columbia; Diversions for Irrigation of the St. Mary and Milk Rivers in Alberta; Power or other problems involving the Pend d'Oreille; the Kootenay; Okanagan, Skagit and other rivers and lakes in British Columbia are indicative of the many and diverse subjects in which this Commission is interested, and frequently especially interested on account of the International complications which exist, or which may arise in connection with the use, or abuse, of such waters.

An International Good Roads Congress for Toronto

THE Second Canadian and International Good Roads Convention is to be held in Toronto from March 22 to 28. It will be recalled that the first meeting was held last spring in Montreal and was attended by over six hundred delegates. This year it is expected that the attendance will number at least one thousand five hundred. The Toronto convention will be presided over by Mr. W. A. McLean, Chief Engineer of Highways, and Commissioner of the Ontario Public Roads and Highways Commission. In all probability the meeting will be held in the Convocation Hall of the University of Toronto. An exhibition of road machinery is to be held and special arrangements are being made for the accommodation of the larger equipment.

At the 1915 convention, other organizations interested in good roads in the Dominion have expressed a desire to participate. Chief among these is the Ontario Good Roads Association, of which Mr. Geo. S. Henry, M.P.P., is Secretary, and which has this year decided to unite its forces with the Dominion Good Roads' Association. Other organizations included are: American Road Builders' Association; American Highway Association; Automobile Club of Canada; York County Highway Commission; Three Rivers' Good Roads Association; Manitoba Good Roads Association; Canadian Automobile Federation; Maritime Good Roads Association; Quebec-Miami International Highway Association; Saskatchewan Highway Association.

The most important question in connection with the Ontario Good Roads programme during the next few years will be the inauguration of the new highways scheme, which entails an expenditure of $30,000,000. Looking to the fulfilment of this scheme it is expected that the first steps will be taken at the forthcoming session of the legislature. The scheme embraces the building of trunk, urban and inter-urban roads. Special attention is to be given to means of creating good traffic exits and entrances for all towns and cities.

During the present year the regulation county road system of the Province of Ontario will proceed as usual, and will work in with the new highway programme. The expenditure in this way will total more than one million dollars, somewhat in excess of last year's. The county pays two-thirds and the Government the remaining one-third of all expenditure, and the roads constructed are a fine macadam.

New legislation in 1915 is expected to provide for the active maintenance of roads, but this has never been emphasized before, and has proved a great source of waste. The Federal Government has been learning a costly lesson in the Province of Quebec in the experience with the Laprairie Dyke Road, which forms a portion of the King Edward Highway. Twice this has fallen down owing to inefficient construction methods.

The Hamilton-Toronto cement road will be completed during the present year at a cost of $750,000. The construction of this is backed by the Government and financed in part by public-spirited citizens. The two cities and the municipalities which benefit will contribute both to construction and up-keep.

The proposal to construct a cross-Province highway from Windsor to Ottawa is now being considered by the Ontario Government. The Provincial Highway Engineer promulgated the scheme as a patriotic undertaking, and motorists and other citizens of the Province stand strongly behind him.

The essential difference between this good roads convention to be held in Toronto in March and previous conventions held in Canada or the United States will be the practical nature of the exhibits and instructions. Figures in regard to depth of roads, weight of traffic, durability, and, in fact, all sides of the cost problem will enable every delegate to inform his associates and constituents exactly how much must be paid for a certain length of road of a certain class of material within certain localities.

Information about the convention can be procured by addressing the Secretary of the Canadian Good Roads Convention, 32 Colborne street, Toronto, or Mr. Geo. A. McNamee, Dominion Good Roads Association, Montreal.

Annual Meeting Toronto Branch, Canadian Society of Civil Engineers

THE Annual Meeting of the Toronto Branch of the Canadian Society of Civil Engineers was held in the Engineers' Club, Toronto, on Thursday evening, January 21st. The retiring chairman, Mr. A. E. Stewart, presided over a large attendance of the members.

Reports of last year's work, which were presented by the Secretary-Treasurer, Mr. John S. Galbraith, were exceedingly good, showing a marked advance over previous years. Reference was made to the fact that an average attendance of 116 had been obtained at the meetings during the year, and to the successful excursion which was made to the New Welland Canal last October, in which 138 members participated. The reports were duly adopted, after which the election of officers and committees took place.

Mr. J. W. R. Ambrose, Chief Engineer, Toronto Terminals Company, was elected Chairman of the Branch for the ensuing year, and Mr. C. H. Fuller, Secretary. Executive Committee—Messrs. J. G. G. Kerry, W. A. Bucke, and Geo. A. McCarthy. Library Committee—W. A. Hare, A. L. Mudge, J. R. Cockburn, and H. J. Bowman. The retiring Secretary, Mr. Galbraith, was complimented on his enthusiastic work during the past year.

C.S.C.E. Toronto Branch Banquet

The members of the Toronto Branch of the Canadian Society of Civil Engineers turned out in force to their Annual Dinner, which was held at the headquarters of the Engineers' Club of Toronto, on the evening of January 18th. The function was the first of the kind to be given by the Branch, and its success was all the more conspicuous by virtue of the fact that the guests of honor were the President and Secretary of the Society, respectively Mr. M. J. Butler, C.M.G., and Prof. C. H. McLeod. Mr. A. F. Stewart (Chief Engineer, Canadian Northern Railway) presided. The toast of the King having been observed loyally, the chairman proposed "The Members of the First Canadian Expeditionary Force," to which response was made by Mr. A. L. Hertzberg, of the Canadian Pacific Railway, who has two sons with the First Contingent, and also by Prof. C. R. Young, of the University of Toronto. Prof. Haultain proposed "Our Guests," to which reply was made by both Mr. Butler and Prof. McLeod. Mr. Willis Chipman, a former President of the Engineers' Club, was one of the speakers.

The following lectures have been delivered recently before the graduate students in Highway Engineering of Columbia University, New York: January 4th, "The Manufacture of Refined Water Gas Tar," Walter H. Fulweiler, Chief Chemist, United Gas Improvement Company, Philadelphia; January 5th, "Chemistry, Manufacture and Testing of Refined Coal Tars and Methods of Transportation," Philip P. Sharples, Chief Chemist, Barret Manufacturing Company, New York; January 11th, "Preliminary Investigations in Highway Engineering—Value and Methods Employed," Maj. W. W. Crosby, Chief Engineer, Maryland Geological and Economic Survey, and Consulting Engineer, Baltimore, Md.; January 18th, "Special Features in Street Cleaning Work—Snow Removal and Annual Municipal Clean-up Week," Wm. H. Connell, Chief, Bureau of Highways and Street Cleaning, Philadelphia, Pa.

P. Q. Architects in Session

IN the absence of Mr. W. S. Maxwell, President of the Province of Quebec Association of Architects, on a business and pleasure trip to Florida, Mr. Joseph Perrault, Vice-President, occupied the chair at the Twenty-Fourth Annual Meeting held in Montreal on the 16th inst. There was an unusually large attendance of members.

The report described the work of the various committees, stating that the fees for members had been raised from $10 to $15, while that for associates and students remained at $3. The following new members had joined: Messrs. J. Rhodin, W. Vandal, D. A. Gascon, Doucet Beaupre, W. A. Aquin, F. R. Findlay, R. Richer, R. Chenevert, E. Latourelle, C. Morin, H. L. Fetherstonaugh, C. McDougal and E. S. Blanchard; from other architectural societies, N. A. Allen, F. R. Foster, S. Warwick, J. P. Hynes, and E. F. Stevens; re-registered, R. A. Frechet and J. Brosseau. With the 21 new members the total was 174. Mr. A. Dunlop, a very old member, had resigned, but the Council had elected him a hon.-member. The Council regretted the loss by death of Prof. Doumic, sometime head of the Architectural Department of the Ecole Polytechnique, who fell while fighting with his regiment in France. He would not have lost his life had he not a few minutes before he was killed insisted on changing places with another officer occupying a very exposed position, saying that the officer had a wife and family, while he had no one dependent upon him. The committee on quantity surveying, of which Mr. D. H. MacVicar is convener, had collected much information from various authorities, and had also issued a circular letter asking for the views of the members. The majority was in favor of the principle, and the committee were of opinion that the outlook for introducing quantity surveying locally was promising, although considerable time will be required for organizing and harmonizing the various interests involved. The Association had co-operated with the National Fire Prevention Association of Canada to obtain reduction in the fire risks, the installation of sprinklers in public buildings and greater power to the Fire Commissioners to jail or punish fire "bugs."

The Quebec section reported that Mr. E. B. Staveley and Mr. J. S. Bergeron had been elected president and secretary respectively.

Mr. Hugh Vallance, the treasurer, stated that the receipts totalled $3,071 and the expenditure $2,597, the society having with the sum brought forward, a balance in hand of $4,117. Four members had gone to the front and the fees of these were to be remitted.

Owing to the war the Association was unanimous in cancelling the annual banquet, subscriptions to the amount of $85 having been taken up instead and forwarded to the "Fraternite des Artistes, France," for the support of families of soldiers fighting for the noble ideas of humanity, liberty and universal peace.

On the suggestion of Mr. J. S. Archibald it was decided to circulate the by-law relating to members soliciting business, etc. He referred to one instance where certain architects had agreed to draw up plans on approval, and spoke strongly on this subject.

Mr. A. Chausse mentioned that the civic committee hoped to have the new Montreal building code printed within a month.

Mr. J. Venne stated that the draft submitted to the City Council was not intended to be a definite set of by-laws; the code was drawn up on general principles only.

The officers elected were as follows:—President, Joseph Perrault; 1st Vice-president, E. B. Staveley (Quebec); 2nd Vice-president, Hugh Vallance; Secretary, J. Emile Vanier; Treasurer, D. Norman MacVicar; Councillors, Messrs. E. Payette, Frank Peden, D. H. Macfarlane, U .J. Asselin, E. I.

Barott; Delegates to the Royal Institute of Architecture of Canada, Messrs. Hugh Vallance, Alcide Chausse, P. E. Nobbs, J. P. Ouellet, Ed. Maxwell.

London Builders' Exchange—Seventeenth Annual Meeting

AT the 17th Annual Meeting of the London Builders' Exchange held on Monday, January 18th, the members named delegates to attend the Provincial Association of Builders' Exchanges at Ottawa in February, and instructed them to bring before that body a number of questions respecting the Workmen's Compensation Act. A resolution was passed declaring it the opinion of the Exchange that building permits should not be issued to any contractor for any piece of work unless he had paid his Workmen's Compensation Assessment, and that each permit should have printed on it the liability of the contractor in case of accident during the construction of the building. These ideas will be presented to the City Council.

President T. R. Wright, who was in the chair, gave an address reviewing the conditions of the past year, which he said had been fairly satisfactory for the various building trades. The programme he outlined for the year dealt mainly with the proposed adjustments of building regulations which were considered necessary to accommodate the Compensation Act.

Officers were elected as follows: President, Mr. T. R. Wright; First Vice-President, Mr. A. C. Nobbs; Second Vice-President, Mr. F. G. Tulett; Secretary-Treasurer, Mr. F. S. Barclay. Directors—Messrs. T. R. Wright, A. C. Nobbs, F. G. Tulett, E. R. Dennis, Geo. S. Gould, L. H. Martyn, John Whittaker, Thos. Beer and Henry Hayman. Representatives to Western Fair—Messrs. Harry Stratfold and G. C. Young. Delegates to the Provincial Association Convention—Messrs. Geo. S. Gould, E. R. Dennis, A. C. Nobbs and T. R. Wright. Auditors—Messrs. Thomas Jones and E. G. Gerry.

Personal Mention

Capt. K. S. MacDonnell, Town Engineer of Barrie, Ont., has been granted leave with full salary on his appointment to the command of the 35th Regiment in the third contingent.

Mr. W. J. Bond who is a well-known building contractor in Woodstock, Ont., has been elected to the City Council as an alderman.

Mr. W. A. McLean, Provincial Engineer of Highways, addressed the students of the engineering department, University of Toronto, recently on "Highway Work in the Province."

Mr. Eugene W. Stern, consulting engineer, New York City, who is a graduate of the School of Practical Science, Toronto, has been appointed chief engineer of the Bureau of Highways, Borough of Manhattan, New Work.

Mr. R. D. Johnson, who formerly filled the position as hydraulic engineer for the Ontario Power Company at Niagara Falls, has opened an office at 60 Wall street, New York, where he intends to practice as a consulting engineer.

Mr. G. L. Ridout, who was in charge of the erection of steel towers for the Hydro-Electric Power Commission of Ontario for some time, has been given a commission as Lieutenant in the department of railways of the Royal Engineers of Lord Kitchener's Army.

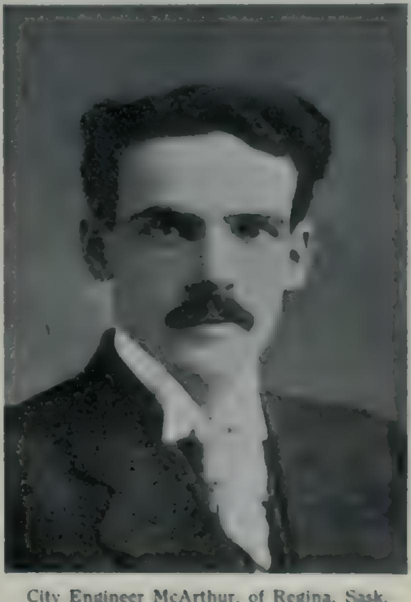
Mr. Gerald D. Case, C.E., of Vancouver, B.C., has been elected to membership of the Institution of Civil Engineers of Great Britain. Mr. Case is the holder of several of the Institution's prizes, including the Miller and the Clarke awards. He will represent the Society in British Columbia.

Mr. J. A. Johnston, who is the author of an interesting paper on Road Foundations published in this issue, is Division Engineer for the Massachusetts Highway Commission, with offices at Springfield. He was born in Boston in 1871. Upon completing his school life he had five years' general engineering experience and then, in 1894, joined the engineering force of the Massachusetts Commission. Eight years ago he was appointed one of five Division Engineers, and was assigned to a district covering the southern-central portion of the State, with headquarters at Worcester. In Massachusetts a Division Engineer is in general charge of the construction and maintenance of State highways, and acts as consulting engineer on similar works for the cities and towns within his territory. In March, 1911, it was decided to make only four Divisions instead of five, and Mr. Johnston's headquarters were removed to Springfield. His operations now extend over the western and southern portions of the State.

Canadian City Engineers

F. McArthur, B. Sc., A.M. Can. Soc. C. E., Regina

FRANKLIN McArthur, City Engineer of Regina, was born in 1885, at Vanderbilt, Michigan. His parents were Canadian, and he was educated at Gore Bay, Ont. In 1903 he entered Queen's University, Kingston, and graduated four years later with the degree of Bachelor of Science. During the summer of 1905, Mr. McArthur was employed on general municipal engineering work and upon power line location for the Ontario Power Company at Niagara Falls, Ont. His next appointment was as Assistant City Engineer at Guelph, in the spring of 1907. Early in the following year he succeeded to the post of City Engineer. In 1909 he went to Yorkton, Sask., as Town Engineer. The following year he formed a partnership with Mr. A. A. Murphy, for the conduct of a general engineering practice at Saskatoon. He entered the employment of the Saskatoon Government as Resident Sanitary Engineer early in 1912, and succeeded to his present office of City Engineer of Regina in August of that year.



City Engineer McArthur, of Regina, Sask.

MAINLY CONSTRUCTIONAL

EAST and WEST — FROM COAST to COAST

The township of Carling, Ont., will vote on a by-law to authorize the provision of funds for building a 66-foot highway.

The fifth pontoon in connection with the proposed drydock for Prince Rupert, B.C., has been launched and construction is progressing rapidly.

The Chatham Dredging & General Contracting Company, Limited, has subscribed one hundred dollars to the Chatham Citizens' Patriotic Fund.

At Maisonneuve, Que., construction is well under way on a public bath estimated to cost $150,000. The architect is Mr. Marius Dufresne, of Montreal.

The Hedley Mining Company, at a cost of $200,000 has completed its power plant at Hedley, B.C. Last year this company paid a dividend of 25 per cent.

The ratepayers of North Bay, Ont., will be asked to vote on a by-law on February 15th to authorize the raising of $60,000 for road and street improvements during the year.

Mr. W. C. Miller, of the building and contracting firm of Miller & Jewurst, Sapperton, B.C., has announced his intention of seeking admission to the municipal council as an alderman.

The erection of a new building at Niagara Falls, Ont., to replace the present Table Rock House will not take place in the immediate future owing to conditions brought about by the war.

The City Council of Vernon, B.C., has decided to enlarge the present sewerage plant and to construct an underdrainage system in the near future. The work will cost approximately $100,000.

In the midst of so many gloomy reports it is distinctly encouraging to learn that as far as building operations are concerned the past year has been one of the best in the history of Campbellton, N.B.

During 1914, railroad construction of 1,978 miles was completed in Canada as against 3,010 in the previous year. In the United States only 1,531 miles of track were laid down, which was less than half of that constructed during 1913.

The concrete piers of the Kettle Valley railway bridge across the Tulameen River, B.C., are complete and work on a Howe truss superstructure is now under way. The excavation of the cut near the east end will complete the line to Princeton.

From a report compiled by the chairman of the Harbor Committee, it is learned that the gross expenditure on the Front street harbor improvement scheme amounts to $477,424. This includes the cost of construction plant, approximately $92,000.

The administration board of the Greater Winnipeg Water District has awarded the contract for digging a channel from Indian Bay to Snowshoe Bay to Mr. C. J. Anderson, Kenora, at $12,765. Work on this section will commence early in March.

The Municipality of Saanich, B.C., will probably proceed without delay on the new waterworks system for which a bylaw authorizing the expenditure of $375,000 was passed last September. Tenderers will be asked shortly to submit figures on the proposed work.

Messrs. Quinlan & Robertson, Montreal, have started work on the Don Section of the Bloor Street Viaduct, the estimated cost of which is placed at nearly $1,000,000. The engineer-in-charge of the work is Mr. T. T. Black.

The announcement has been made by Sir Richard McBride, Premier of British Columbia, that the erection of permanent buildings in the new university will have to be postponed for financial reasons. Plans for the new buildings had already been completed.

The Railway Commission has approved of plans submitted for the construction of a new depot at New Westminster, B.C., for the Great Northern Railway Company. Tenders are in and it is anticipated that the contract will be let and that work will proceed without delay.

The Thorold, Ont., Board of Trade at its annual meeting a few days ago issued a strong protest against the export of nickel from Canada. A resolution was also passed in favor of memoralizing the government, requesting the adoption of measures to prohibit free exportation of the product.

The Fort William building programme for 1915 will include the construction of an important addition, to the exten of three-quarters of a million bushels, to the elevator capacity of the Ogilvie Flour Mills Company. This will bring the total storage capacity of the company to about 2,000,000 bushels.

The construction of a new city hall and jail combined is being considered by the Nanaimo (B.C.) Council. At a recent meeting the engineer was instructed to prepare plans for a structure which would cost approximately $27,000. The council has also decided to expend $10,000 on sewerage extensions.

The plant of the Canadian Steel Foundries, Limited, Montreal, is reported to have secured the contract to manufacture the castings for twenty submarines which are to be constructed by Vickers, Sons & Maxim for the service of Great Britain. The firm have opened a sales office in London, Eng.

An order for 120,000 shovels has been placed in Canada by the British war office. It is divided between the Jones Shovel Company, Gananoque, Ont., and the Hamilton Shovel Company, of Hamilton. The shovels will be delivered in weekly shipments and the order calls for completion within two months.

The Mueller Manufacturing Company of Sarnia, Ont., has received an extensive order for the supply of war material. This necessitates the installing of new machinery and the employing of a large number of additional men. It is stated that the machinery has already been purchased in Canada at a cost of $20,000.

The Vancouver Terminal Railway Company has notified the city council of its intention to apply to the Dominion Parliament next session for incorporation and authority to construct railway and terminal works and tunnels, also to transfer and connect tracks with other railways between

Vancouver and Westminster and the mouth of the Fraser River.

The Liverpool, London & Globe Insurance Company's new building at Montreal, the expenditure on which is estimated to amount to $175,000, has reached the plastering stage. The architects are Messrs. Nobbs & Hyde, and the general contractors are Messrs. E. G. M. Cape & Company, Limited, both of Montreal.

At Calgary, Alta., work on the construction of concrete piers for the Centre street bridge is ready to proceed. The engineering department has been requested to report on the probable cost and the city commissioners are said to favor the carrying out of work forthwith owing to the fact that labor and material favor present activity.

London, Ont., is to be the centre of an important meeting of delegates representing all municipalities between St. Marys and Exeter, for the purpose of requesting the government to construct a new radial line for extensive territory at present unserved. The plans provide for a connection via London with systems to be built to Windsor and Sarnia.

According to Mr. J. D. McArthur, contractor for the Hudson Bay Railway, who visited Ottawa recently, about 300 miles of road have been graded, while rails have been laid for a distance of 200 miles. It is predicted that grading will be completed to Port Nelson next summer, though it will probably be eighteen months before the rails are laid.

Application will be made to the Dominion parliament for legislation to incorporate the Entwhistle & Alberta Southern Railway with power to build a line from a point on the Grand Trunk Pacific at Entwhistle in a southerly direction to a point on the Saskatchewan River near the boundary line between townships 47 and 48. The road would extend for 50 miles.

Work on the construction of the handsome quarters of the Victoria Units of the Canadian Militia is progressing satisfactorily at the hands of the contractors, Perfitt Brothers. In a few weeks the contractors expect to make a large addition to the number of men employed and the building will probably be completed in June. Major W. Ridgway Wilson is the architect.

The Polson Iron & Shipbuilding Company, Toronto, have been given portion of a large contract which has been subdivided between a number of Canadian firms for the manufacture of shrapnel shells for the government. The firm is installing a special plant which will be one of the most complete of its kind in Canada. The satisfying announcement was made by Col. J. B. Miller, president and general manager, that the plant is working day and night in order to fill ship-building contracts.

Toronto's record of building permits for the past year totals $20,694,288, a decrease of about $7,000,000 from that of 1913. The number of permits for brick dwellings taken out in 1914 totalled in value $8,818,627. Seventy-four permits for factories, amounting to $1,677,650, were issued and 32 permits for school buildings estimated in value at $1,666,800. New stores erected during the year totalled 403 in number and in value $1,386,365. The expenditure on warehouses amounted to $1,269,700, representing 35 permits.

According to reports from Ottawa the war is making no difference with Government expenditures on the big public undertakings. Last year ordinary or consolidated outlays were $13,000,000 and this year, in the corresponding nine months, $14,000,000. Railway outlays last year were $10,000,000, this year $15,000,000. Railway subsidy payments, however, have declined by $12,000,000. In regard to smaller public works there is a tendency to economize, but all the big ones are going ahead, money being put into circulation, and employment being furnished to thousands.

New Elevator Factory at Montreal

THE A. B. See Electric Elevator Company of Canada, Limited, has completed during the war a large elevator factory in the heart of Montreal. The plant, a brick building two storeys high, adjoins the new Sun Life Building, and extends through from Metcalfe to Mansfield streets, having its main entrance on the latter street. It is the intention of the company to make everything in Canada in future. This is evidenced by the completeness of the manufacturing equipment.

From a national viewpoint it is interesting to observe this move on the part of the See Company—as their manufacturing plans were matured after the outbreak of hostilities. The directors believed so firmly in the future of Canada that they decided that the best way to make use of the dull days, and, in addition, give employment to their people, was to go right ahead with the equipment of their Canadian plant instead of waiting until the autumn of 1915 as had been originally planned. The A. B. See Company of Canada can now rightly claim to be a distinctly Canadian Company. It is controlled by the wealthy parent company in New York whose name it bears, but it is officered entirely by Canadians.

The company has secured many large elevator contracts in Canada during the last year, including contracts for the Dominion Government, the Methodist Book Room Building, the Sun Life Building, and the Merchants' Bank Building. The firm manufacture every kind of electric elevator and dumbwaiter.

Factory of A. B. See Electric Elevator Company of Canada, Limited.

The Algoma Steel Corporation, Limited, manufacturers of steel rails, splice bars, tie plates, forging billets, concrete bars, pig iron, etc., are re-opening their Montreal office, which is now in charge of Mr. G. A. Irwin, whose headquarters are in the McGill Building, McGill street. We note that while the company specialize in steel rails and accessories, they are also equipped to manufacture a certain range of merchant mill products, including beams, angles, channels, bars and rounds

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A world's record for tunnel boring has been established by the firm of Foley Bros., Welch & Stewart, contractors on the C. P. R. Rogers Pass Tunnel scheme. According to Mr. A. C. Dennis, superintendent of construction for the contractors, 817 feet of "pioneer" heading was excavated in a single month as against 810 feet, the record for the United States in the same period. Mr. Dennis states that the next two miles through the heart of the mountain will have to be dug out of a particularly hard kind of rock. At the present rate of projection it is estimated that the tunel will be completed in the summer of 1916.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Aylmer, Que.
The ratepayers of this town have defeated a by-law seeking to devote $15,000 to the construction of a filtration plant.

A by-law to authorize the construction of an intake pipe, at an estimated cost of $12,000, was passed by the ratepayers on January 19th. Mr. Malherbe is the Town Clerk. Mr. Leblanc is Town Engineer.

Alexandria, Ont.
The ratepayers of this town have passed a by-law authorizing the expenditure of $5,000 on extensions to waterworks and electric lighting plant. The Town Clerk is Mr. S. MacDonnell.

Brockville, Ont.
The Provincial Sanitary Engineer, F. A. Dallyn, has recommended the construction of a 4,000,000-gal. filtration plant. It is anticipated that the request will be acted upon immediately. Mr. Geo. H. Dewey is City Clerk, Mr. G. H. Bryson, Engineer.

Dunnville, Ont.
A by-law to raise $12,000 to defray the cost of waterworks extensions already completed has been passed by the ratepayers.

Hamilton, Ont.
The City Council has received a recommendation from the Fire Chief in favor of the construction this year, of a reservoir for the city.

Kaslo, B.C.
The City Council has decided to expend $5,000 on the carrying out of necessary improvements to the waterworks system. Mr. W. E. Hodder is City Clerk.

London, Ont.
The City Engineer, Mr. H. A. Brazier, has commenced work by day labor on the construction of additional storm and sanitary sewers. The estimated cost of the work is $14,000.

Tenders will be received by the Board of Control until January 29th, for tile sewers for the following streets: William Street, from Cheapside to Victoria; Colborne, from Horton to Bathurst; Langarth, from Cathcart to Edward. Contracts will be let February 1st.

Moose Jaw, Sask.
The City Council has provided for the laying of Rocmac paving on a number of streets this year. The work will be done by day labor, under the supervision of Engineer G. D. Mackie. Mr. E. B. Bonell is City Clerk.

North Bay, Ont.
A by-law to raise $60,000 for improvements to streets and roads will be submitted shortly to the ratepayers for approval.

New Westminster, B.C.
The City Council has voted $10,000 for extensions to the city's sewerage system. Mr. T. W. B. Blackman is City Engineer.

Ottawa, Ont.
Tenders will be called shortly by the Secretary, Board of Control, and will be received until February 23rd, for the supply of vitrified clay pipe, Scotch and Canadian, for 1915. Specification when ready, may be obtained from Mr. F. C. Askwith, City Engineer, and at office of MacLean Daily Reports, Limited, Toronto.

Park Hill, Ont.
The ratepayers have approved a by-law to expend $3,000 on extensions to the waterworks system.

South Vancouver, B.C.
The ratepayers of this city will vote on a by-law to authorize the expenditure of $57,767 on road improvements. This sum is the unexpended balance of money raised by previous by-laws. Mr. S. B. Bennett is City Engineer.

Toronto, Ont.
The proposed drainage system to be installed in Willowdale Cemetary has been approved by Dr. C. A. Warren, M. O. H. for York Township.

The Lambton Park Ratepayers' Association has decided to urge the York Township Council to lay a storm water sewer on St. Clair Avenue, and thence to the Humber, also to purchase a site for disposal plant. Mr. W. A. Clark, 40 Jarvis Street, is Township Clerk. Mr. J. Bell is President, Lambton Park Ratepayers' Association.

The Board of Control has referred the tenders for part of Section 2, High Level Interceptor to Mr. R. C. Harris, Commissioner of Works, for his report.

Victoria, B.C.
The City Council has in contemplation the construction of a sewer on Oakland Avenue. The City Engineer, Mr. C. H. Rust, has recommended that the work be commenced without delay.

CONTRACTS AWARDED

Point Grey, B.C.
The Municipal Council has awarded contracts as follows for paving work on University Ave.: Ledingham & Cooper, Vancouver, bituminous pavement, with 5½-in. concrete bed; Cotton Company, Limited, Vancouver, concrete pavement. It is understood that the specification calls for the use of paving brick for the surface later on.

Toronto, Ont.
The following contracts for sewers have been let by the Board of Control: Routly & Summers, Aldergrove, $297, Aldridge $653, Beachview $831, Brookside $1,611, Daulac $525, Drofnas $395, Gibson $254, Mendal $350, Murdock $516, Street off Wrenson Road $492. Grant Contracting Company, Firstbrook Road $950, Glenmount Road $2,280.

York Township Council has awarded the contract for the construction of a sewer from Oakwood Avenue, 2,010 ft. long, to Mr. W. E. Taylor, 438 Clinton Street. Mr. F. Barber, 57 Adelaide St. E., is Township Engineer.

Winnipeg, Man.
The general contract for excavating channel between Indian Bay and Snowshoe Bay (Arm of Shoal Lake), which means approximately 37,000 yards of excavation, has been awarded to Mr. C. J. Anderson, Kenora, Ont. The Greater Winnipeg Water District, 901 Boyd Building, are the owners.

Railroads, Bridges and Wharves

Charlottetown, P.E.I.
The Secretary, Provincial Government Department of Public Works, Mr. L. B. MacMillan, Charlottetown, will receive tenders until noon, January 27th, for constructing five bridges in Queen's County, known as Shea's, West Cape, Whaleback, Malpeque, and Summerside Road. Plans and specification are at the Department, Charlottetown.

Metcalfe Twp., Ont.
The Twp. Clerk, Mr. Harry Thompson, Kerwood, Ont., will receive tenders until February 13th for the construction of a steel bridge across Steer's Creek.

Ottawa, Ont.
Plans are in progress for the construction of a bridge across Main Street, steel frame and wood construction, for the City Council. Mr. F. C. Askwith is the engineer.

Toronto, Ont.
The Commissioner of Works, Mr. R. C. Harris, City Hall, has had plans prepared for a new bridge across Belt Line tracks, in connection with the extension of Mount Pleasant Road.

Victoria, B.C.
Application has been made by the City Council to the Dominion Department of Marine & Fisheries, requesting permission to build a wharf at Garbally yards for accommodation of paving plant. The City Clerk is Mr. W. A. Duncan.

Wolford and South Emsley Twps., Ont.
In connection with the construction of steel and concrete bridge over Otter Creek for Leeds and Grenville Counties, the cement work will probably be carried out by day labor under the supervision of Mr. E. R. Blackwell, Engineer, Bennet Street, Brockville.

CONTRACTS AWARDED

New Westminster, B.C.
Prices on plastering, electric wiring,

ESTABLISHED 1886

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The Nickel Quession

HOWEVER the interests of the Government and the International Nickel Company may be mixed up, to whatever extent one party may have committed itself to the other, and in spite of all the elusive statements that are forthcoming in regard to the exportation of nickel, it is becoming more and more apparent that the people of Canada want this question settled. The men who constitute the country's real backbone will not rest until Canada takes a definite step to retrieve her position in the eyes of the rest of the Empire. They are not satisfied that the men who have become involved in the interests of the International Nickel Company are representative of true Canadian sentiment, which, to say the least, should not lag behind that of Australia, who cut off Germany's supply of wool by refusing to sell to neutral countries without a definite guarantee that neither the wool nor the product thereof would find its way to the enemies of the British Empire. Australia's position, of course, is entirely different from Canada's. Australia's wool is controlled by Australia; Canada's nickel is in the hands of a German exporting company.

It is a strong statement, perhaps, but in our opin-

A Reader's Viewpoint

Toronto, January 29, 1915.

Editor, Contract Record:

I have read with much interest the editorial article in your issue of January 27, regarding the exportation of nickel from Canada. It is gratifying to note that this important question is receiving more and more attention from the press. It is only by constant agitation and by bringing the matter clearly before the public that the Government can be aroused into action and induced to come forward with a statement as to their policy regarding reduction plants in Canada.

Surely the people of Canada have a right to know exactly what steps are being taken. It is difficult to enter into an intelligent discussion of this important question without being in full possession of facts and details. These appear to be within the exclusive ownership of the International Nickel Company and the Government, and neither party seems anxious to make its information public.

The people of Canada ask, **If the Government has absolute proof that Canadian nickel is not going to the Allies' enemies, why does it not make a statement as to how this proof has been arrived at and set all our minds at rest? If the British Government is satisfied that contraband of war is not being shipped from the United States to Germany, why should it persist in searching American vessels?**

It is certainly the duty of the Canadian Government to give the Canadian people more enlightenment on such a vital subject. I trust that you will continue your good work and that your example will be followed by other influential journals.

Yours very truly,
Charles C. Clark, A.M.I.E.E.

ion the Canadian Government is prostituting the interests of the Empire and betraying every man, woman and child in that Empire by not placing an immediate prohibition upon the export of nickel and maintaining it until the question is definitely settled as to how the nickel is to leave Canada and where it is to go.

History teaches us that upon such national questions the United States must be tied down beyond any possibility of wriggling, let alone escape. The point is well taken that the measures adopted by England in regard to rubber leaving the Empire for the United States are directly opposed to those taken by Canada in regard to its supply of nickel. It is admitted that 90 per cent. of the high-grade rubber used by United States manufacturers in tires and other goods is obtained from British East India. Rubber, like nickel, is a war commodity of great importance and England uses her whip hand with absolute effect. Canada allows herself to be duped into betrayal.

Apart from the aspect of the question as it regards the enemy, there is the question of our own industrial development. The cry of "Made in Canada!" is heard on all sides. From selfish motives alone we should put this into practice, refining our nickel in Canada and producing the finished article. **Here is a part for the Canadian Manufacturers' Association and an outlet for its activities.**

Canada, so far, has made a big loyalty noise, but with the passing of the tumult and the shouting we find nothing done. Australia has cut off the enemy's supply of wool and New Zealand his wheat, the while Canadian produce is filling his belly and Canadian nickel is going into the manufacture of the dread implements of war which he is employing for our destruction.

There is not a man in Canada today—at least not a man possessed of real backbone and having British blood in his veins—who is not concerned with his responsibility in this vital question.

The Twenty-Ninth Annual Meeting of the Canadian Society of Civil Engineers

(Staff Report)

MEMBERS of the Canadian Society of Civil Engineers, to the number of some three hundred, held their Twenty-ninth Annual Meeting at the Society headquarters, 176 Mansfield street, Montreal, from January 26 to 28. The attendance included members from all parts of the Dominion, but as usual the majority were residents of Montreal or from places within easy reach of the city. Messrs. J. Duchastel, A. Surveyer, E. S. Mattice, A. Amos, W. J. Dick, and E. W. Oliver acted as a reception committee.

At the first session on the morning of Tuesday, January 26, the President read a telegram from the Edmonton Branch, expressing a hope for additional prosperity for the Society, and also that the members might look forward to provincial associations being formed. The Treasurer's report was adopted, after a discussion as to the best means of collecting fees in arrears.

The reports of the Vancouver, Manitoba, Toronto, Ottawa, Kingston, Quebec, Victoria, Calgary and Edmonton branches were read; these showed, as the President remarked, a generally healthy and progressive condition. The report of Toronto was especially good, and in this connection, Prof. Haultain said a word for the hard work and excellent results achieved by the officers.

The Report on Conservation was read by Mr. James White.

The report of the committee on specifications for cast iron steel water pipes stated that the committee had carefully considered whether or not in view of the best practice in the manufacture of cast iron water pipes any revision of the Society's specifications were desirable, and they had come to the conclusion that the present cast iron pipe specifications met every requirement. In regard to the matter of steel pipe for water works purposes, it was the opinion of the committee that the time had not yet arrived for standard specifications to be drawn up by the society. Hundreds of miles of steel pipe for force mains, feeders, distribution pipes, etc., are in successful operation in this country and elsewhere, and the committee were of opinion that there was not sufficient unanimity amongst engineers and the different manufacturers as to standard practice to go upon in the drawing up of specifications to warrant a recommendation. There were however signs that standardization might be possible in the near future, and the committee suggested it was desirable to continue in order that they might be able to keep in touch with developments.

It was announced that the Gzowski Medal had been awarded to Mr. P. A. N. Seurot, Montreal, for his paper on "Subaqueous Tunnelling."

The President stated that he had taken up with Sir Percy Girouard the question of a railway construction company, in order to assist the War Office, but Sir Percy was of opinion that at present no such assistance was necessary.

After the adjournment the visiting members were entertained at luncheon by the Montreal members.

The afternoon session was devoted to a discussion of the Report of the committee on Concrete and Reinforced Concrete and the President's address.

The report was submitted by Mr. Walter J. Francis, the chairman of the committee, who explained that the document was intended to be broad, comprehensive, and general, it having been the purpose of the committee that the specifications should be used by engineers at large. Mr. L. S. Bruner seconded the adoption of the report.

Considerable discussion took place as to certain clauses, exception being taken to clause 16, relating to loads on building columns, as unnecessary. Mr. Francis replied it was of the utmost importance that the clause be included. The case of columns presented one of the most controversial questions in reinforced concrete designing. The clause represented the best practice in tall buildings, while it could easily be omitted if so desired by any engineer.

In a written criticism, Mr. J. V. Dillabough, Winnipeg, objected to the words "as far as practicable" and similar phrases, but Mr. Francis replied that from personal experience he knew such words were desirable.

Messrs. Bruner, Haultain, Holgate, and others spoke on the subject of inspection and commended the committee's clause as being essential. All agreed that constant inspection of concrete work was imperative, whether done by a contractor or by workman for companies carrying out jobs.

The report was then agreed to.

Mr. Butler's address was a comprehensive review of Canadian transportation, trade, and population from 1907 to 1913. He commenced with a reference to the European situation and expressed satisfaction with belonging to an Empire which honoured "scraps of paper." Figures relating to railway mileage, earnings, expenses, etc., were then given, Mr. Butler pointing out that Canada had the greatest mileage per head of population of any country in the world. The greatest problem before the country was that of transportation.

"We have," continued Mr. Butler, "as a nation, undertaken the task of forcing our outlets against the line of least resistance. The Atlantic seaboard is the outlet for the products of the prairies, situated some 1,500 miles inland. Our efforts in building railways with easy curves and grades, the enlargement of our canal system and the improvement of rivers, and particularly of the St. Lawrence route, have but the one object of putting a few more cents a bushel into the pockets of our farmers. The enlargement of the Welland Canal will allow the larger type of ship of 300,000 bushels capacity to pass down Lake Ontario and the river St. Lawrence to within 120 miles of Montreal. Great storage elevators will be erected at or near Prescott, and 1,000-ton barges will be towed through the present canal system to Montreal. Each incoming ship is known for days ahead, and the exact cargo of grain required can be in waiting for transfer by floating elevators.

"Ultimately, however, the larger lake ship will come through to Montreal, as it is quite practicable, and within the resources of the country, to convert the St. Lawrence river into slack water navigation by the building of eight dams, with duplicate locks, and as an incident thereof develop the greatest water power in the world, aggregating over 4,000,000 horse-power, eliminate the ice jams, and make practicable the navigation of the river in winter by the aid of powerful icebreakers.

"It is a duty which our government may well undertake at the earliest possible moment to secure a hydrographic and topographic survey of the St. Lawrence, so that accurate estimates of cost may be made, and proper regulations may be drawn to so regulate proposed power developments owned by private corporations that each may be brought into a component part of the completed whole. It would be difficult to place a limit upon the possibilities of such a power development situated on the greatest transportation route in the world. Cheap and abundant power means so much to a country."

The President then touched on trade possibilities, quoting figures to show our commercial expansion. "A marked feature of our trade is the importation of steel products and manufactures of which steel is an important constituent. For 1911 we brought in $85,319,541. of $11,448,028 were on the free list. We also imported fire clay and fire brick to the value of $994,193, all on the free list. I have no desire to infringe upon the boundary lines of politics, but may be permitted to point out that such a tremendous balance of trade against us is one that thoughtful men may well ask how it is to be dealt with. I venture to say that by a careful readjustment of the tariff quite 50 per cent. of the importations may be profitably carried on in Canada. We have been large borrowers in the world's markets, spending money lavishly and on the whole wisely. Here and there over-capitalisation, ill considered industrials, may be found, but the time has arrived when we must economise, pay our way, write down inflated capital, and show the loaning world Canada is solvent and worthy of the trust and confidence shown us. I have no doubt as to the ultimate result. Our resources of unworked land, our mines, forests and fisheries will give homes and opportunities for millions of men." Mr. Butler alluded to the tendency of people to become city and town dwellers instead of going on to the land; this was not satisfactory and efforts will be needed to remedy this condition. In concluding the President spoke with regret of the deaths of Mr. T. C. Keefer and Dean Galbraith; the former he described as a great man as well as a great engineer, and the latter as one whose work will live after him.

Mr. F. C. Gamble, the new President.

It was decided to send telegrams to Col. Mitchell and others serving on Salisbury Plains and also to other members serving in the French Army.

In the evening a smoking concert was held in the society's rooms, at which Mr. H. F. V. Meurling, a member, gave an illustrated talk on submarine mining for coast defence.

Wednesday morning was devoted to visits to the plant of the Cedars Rapids Manufacturing and Power Company, and to the Angus Shops. At the former, Fraser, Brace and Company, the contractors, entertained the delegates at luncheon.

During Wednesday afternoon's session the delegates took up the report of the Committee on General Clauses for Specifications,* of which Mr. H. Holgate is chairman. This report, said Mr. Holgate, was a compilation of specifications from various sources. It did not pretend to be complete or final. There had been some criticisms, chiefly from the contracting end of the profession. The clauses, however, were drawn up from the point of view of the engineer.

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* See p. 111.

Mr. H. R. Safford drew attention to Clause 43, under which the contractor could not claim any damages or reimbursements whatever for delays from any cause during the performance of the work. He thought it was unfair, and suggested the inclusion of a clause by which a contractor could claim damages under certain conditions.

Mr. Holgate agreed that something of this nature was necessary.

Mr. G. H. Duggan was of opinion that the specifications were unfair to a large class of contractors, and he would not sign a contract with these specifications included unless he was assured of the integrity of the engineer. He discussed the clauses in detail, and urged that the general tendency was to put obligations upon contractors which were not just, and which might lead to litigation. He admitted that his criticisms were from the contractors' point of view, but he reminded the members that the best specifications were those which were fair to contractors, engineers and proprietors.

Mr. Walter J. Francis spoke of the trouble caused by contractors not being supplied with plans. The Dominion Government were great sinners in this respect. He sympathised with Mr. Duggan in many of his remarks.

Mr. S. P. Brown pointed out that the contractors' status had greatly improved, and that many contractors were as capable as engineers and had to meet more difficult situations. The clauses were really meant to be modified or adopted in order to meet each individual case.

Mr. Holgate stated that he had used the clauses for nine years and had found them efficient; they were simply clauses and not specifications.

The President stated that this was a subject which was receiving great attention throughout the American continent. He remarked that the Contract Record and Canadian Engineer had referred to the subject, and allegations made as to the rut into which specifications drawn up by engineers had gradually grown. His personal experience was that contractors had too many handicaps which ought not to be put upon them. Nothing should be left to opinions; it was well enough when matters were in the hands of competent and trained men, but engineers had a multitude of assistants, some without experience, and some without any idea of the true intent of contracts. It was a good thing to have a well written and prepared set of clauses. The clauses under discussion were general clauses for the guidance of engineers; if the members of the society thought it was not a safe thing to trust these to engineers, then let them bring in a lawyer to draw up documents. He thought that the phrase "in the engineer's opinion" which occurred in the clauses was a most offensive one, and should be eliminated.

Mr. E. W. Oliver declared that it was important that all specifications should be so worded as to stand the sand blast of the courts, and that loose specifications were a fruitful source of litigation.

In the course of further discussion the personality of the engineer in charge was emphasized, particularly in the matter of avoiding disputes. A great deal also depended upon whether the contractor in signing the contract did so with faith in the engineer and with willingness to take chances on a liberal interpretation of the specifications if he were determined to follow its real purpose and spirit.

In compliance with a generally expressed wish, the report was referred back, Messrs. Duggan and Safford being added to the committee. It was also decided to give authority to the committee to call in a lawyer to advise the committee.

The members then briefly discussed the reports of the Committee on Rails and the Committee on Track, which were adopted.

The Closing Sessions

The greater part of Thursday's session was occupied by a discussion on the status of civil engineers, introduced by Mr. F. C. Gamble, who said in part: "As you are aware, civil engineering as a liberal profession is at a decided disadvantage, not being duly legalized in a manner similar to the legal, medical, and land surveyors' professions. Any one, no matter how deficient his qualifications and experiences may be, can call himself a civil engineer and undertake to design and carry out works. This often brings the profession into contempt. Governments, including that of municipalities, have the power, if they choose to exercise it—and sometimes they do—to appoint a person having no regard to his lack of skill and character, to a responsible position, which should be filled only by a corporate member of a national civil engineering society, of good standing, and dub this individual an "engineer."

"Further, provincial land surveyors, not members of an engineering society, frequently call themselves civil engineers, being under the impression that this title gives them an added dignity; while civil engineers who are just as qualified by their training to survey lands as a commissioned land surveyor, and whose knowledge is extensive and far-reaching, are not permitted to survey even a right-of-way of a railway, or of any land required for the purpose of any works they may have in hand. I mean by this that no plans prepared by a civil engineer of the lands required in connection with his work is acceptable to the land registration office. I intend no disparagement to the profession of the land surveyor. It is an honourable one. I know that those of them who devote themselves entirely to land surveying will agree with me, that the two professions, as they now exist, should be kept separate and distinct. As the civil engineer cannot encroach upon the protected rights of the land surveyor, so ought the civil engineer to be protected against the encroachment of the land surveyor, as well as that of others who are not surveyors and who do not possess the ordinary qualifications of a civil engineer.

"Now what is the reason for this anomalous and humiliating position in which we find ourselves? I think it may be attributed in the first place to the ignorance and astonishing indifference of the general public—their inability to differentiate between an engineer and a surveyor, and to the apathy of some members of our own profession, or rather society. The latter, who are guilty of this indifference, show a lack of pride in and a want of a sense of responsibility towards their profession. So dense is the ignorance of the general public—and among them are many who should know better—and so inpenetrable is the apathy or indifference of some of our members, that it is immaterial to either of them, whether a man is called a civil engineer or a surveyor. They do not trouble to distinguish between them.

"The question therefore now arises,—what steps should first be taken to remove the disabilities under which we now labor?

"In my opinion, and it is the opinion of the majority of members in British Columbia, the suggestion of licensing and registration by government of civil engineers, or by an act of close incorporation, are all out of the question. At any rate they are undesirable as of no present value towards improving our standard; but even if thought desirable are unattainable. The members in British Columbia have carefully considered and discussed the matter and have arrived at the conclusion, that the simple definition of the word "engineer" as a civil engineer, a corporate member of a great national society, ought to be a clause incorporated in the interpretation act of all statutes, or if thought more desirable by a special act of the Legislature defining the word "engineer" as I have pointed out. Such a clause will, of course, apply only for the present, at least, to Government work, but we are of the opinion that in time, those engaged in private enterprises will perceive the advantage of adopting the same standard.

"We submit that such a definition as we propose will work injury to any competent practising engineer outside the Society. If he is really competent he need not hesitate to apply for membership and will have no difficulty in being accepted as a corporate member of the Society, if his record is good. Instead of being hampered by such a condition, he will be materially benefited thereby, and coming into contact with the members, his views will become broadened. He will receive valuable instructions and hints in the latest developments and advances in scientific engineering, and in all things pertaining to the humanities. Personal contact with our fellowmen is always in itself a liberal education. It is proposed that if we are unable to obtain the clause defining the word "engineer," we ask the government to eliminate from all acts the word "engineer," on the ground that no one has the right to use so significantly a distinguishing title without possessing the absolutely requisite qualifications. The present position of the engineering profession in this respect is repugnant to all sense of justice, and it is the imperative duty of the members of this society to see that a proper remedy is applied."

Mr. Gamble concluded by moving: That this meeting being in hearty sympathy with the suggestion that the term "civil engineer" be given a legal definition, expresses a wish that the incoming council will give the matter early serious consideration to the end that governments will be induced in justice to the profession of civil engineering to accept the definition proposed and amend such public acts as may be necessary to give legal effect to such definition."

Mr. E. W. Oliver, in seconding the motion, remarked that the profession was brought into disrepute by so-called engineers. The engineering profession had not made such progress as some of the mercantile branches. He recalled a recent instance in Toronto, where a so-called engineer who had no training masqueraded before the public and who was now on a long vacation. This man had been called into advise on public work and had adopted the plans of an engineer. Some action to prevent such abuses should be taken, in order to protect the public.

Mr. S. P. Brown asked whether having regard to the mention of engineers in public documents the resolution would not be embarrasing if it should be retroactive.

The President said that so far as he was aware the expression "engineer" was only used in provincial acts referring to drainage, ditches, etc.

Mr. W. F. Tye was against any legislation on this subject if it was in the nature of trades unionism.

Mr. H. Holgate stated that this subject was fully discussed some years ago and dropped. The American Society of Engineers had no definition of an engineer.

The resolution was agreed to with a few dissentients.

The President announced that the following were elected as nominating committee: District No. 1, C. N. Monsarrat; No. 2, W. A. Hendry; No. 3, S. A. Oliver; No. 4, L. W. Gill; No. 5, E. W. Oliver; No. 6, H. W. Ruttan; No. 7, R. W. McIntyre.

The election of officers resulted as follows:—President, F. C. Gamble; vice-president for three years, A. St. Laurent; vice-president for one year, E. E. Brydone-Jack; Council, District No. 1, S. P. Brown; No. 2, C. B. Brown; No. 3, T. A. J. Forrester; No. 4, A. A. Dion; No. 5, J. L. Weller; No. 6, W. G. Chase; No. 7, W. J. Kerr.

Mr. Gamble then took the chair, and briefly thanked the members for his election. He also on behalf of the Vancouver and Victoria branches extended an invitation to members to visit Victoria in June on the occasion of a summer convention to be held there.

On the suggestion of Mr. Holgate, the Council asked to consider placing in the society's headquarters a permanent memorial of late Mr. T. C. Keefer, the first president, and also to arrange for writing a memoir of his life.

It was also decided to send a letter of greeting to each member of the society with the Overseas Contingent.

Votes of thanks to the President, Council, reception committee and others concluded the convention.

The Annual Banquet

The 29th annual banquet of the Society was held on the evening of January 28th, when an eloquent address was delivered by the Hon. Sir George Foster, Minister of Trade and Commerce. Another distinguished speaker was the Hon. W. S. Fielding, ex-Minister of Finance. The chairman of the evening was the retiring president, Mr. M. J. Butler, C.M.G. At the head table in addition to those already mentioned there were Messrs. E. Marceau, John Kennedy, F. C. Gamble (the new president), Phelps Johnson, G. A. Mountain, W. B. McNab and Col. Anderson. Some points from the address of Sir George Foster will be published in our next issue.

Report of the Committee on General Clauses for Specifications

Members of the Committee: E. G. M. Cape, R. de L. French, W. Chipman, J. G. G. Kerry and H. Holgate, Chairman

IN compliance with instructions given by the annual meeting of January last, the Committee appointed to report on General Clauses for Specifications has met several times, and a good deal of correspondence has passed between the members of the Committee. We beg to submit our report which will no doubt come up for discussion at the next annual meeting.

We have compiled the accompanying form of general clauses from various sources, and have revised, altered and added to them as we thought necessary. We have arranged them in a manner which, we hope, will be satisfactory, and have endeavored to cover the necessities of various classes of work.

By the use of this or a similar form of general conditions, the form of contract and of the specification can be very much abbreviated, as many of these clauses would of necessity be incorporated in either the contract or specification, and by its use the standardization of forms of contract would be advanced.

Though perhaps somewhat beyond the question that we have been asked to report on, we would recommend that all contracts should embrace in one document:—1st., the agreement or contract itself; 2nd., the tender or a certified copy of it; 3rd., the specification; 4th., the general clauses; 5th., the signed drawings as tendered on; 6th., any modified drawings agreed to prior to signing of contract.

Preferably these should be printed documents.

In case of the adoption of a form of General Conditions we would suggest that the Society have it printed and sold to the membership at a moderate charge.

GENERAL CLAUSES

Definition of Terms

1. Grammatical variations in number and gender of terms used.—Wherever applicable, a reference to any person or thing in the masculine gender or singular number shall be interpreted as if it were in the feminine or neuter gender or in the plural number, as the case may be, or vice versa.

2. Definition of "Contract."—The "Contract" shall mean the mutual understanding and agreement between the Purchaser and the Contractor, as expressed by the Contract and the signed plans and documents forming part of it. It is understood that at the date of signing the Contract all understandings apart from those actually expressed in writing in the Contract are of no effect. The Contract shall be understood to embody the full and complete understanding.

3. Definition of "Purchaser."—The "Purchaser" shall mean the person who agrees to pay for the work, and shall include his heirs, administrators, executors and assigns.

4. Definition of "Contractor."—The "Contractor" shall mean the person who agrees to do his work, and shall include his heirs, administrators, executors and assigns.

5. Definition of "Person."—"Person" shall, wherever it can apply mean and include individual, firm, syndicate and body corporate or politic.

6. Definition of "Work."—"Work" shall mean the whole or any part of the work to be done under the contract, whether completed or uncompleted, and whether as originally set forth or as varied by the Engineer, and any or all of the labor, materials, apparatus and equipment to be used or supplied by the Contractor.

7. Definition of "Plant."—"Plant" shall mean all tools, instruments, animals, vehicles, tackle, engines, boilers, machinery, power, temporary structures, sheds, lumber, shoring, centering, forms, derricks and any or all appliances which shall be constructed upon or brought to the site for use on the work.

8. Definition of "Site."—"The Site" shall mean the place where the work is to be performed or such place as is particularly named or described in the contract, including the approaches thereto.

9. Definition of "Approved."—"Approved," when used in connection with or referring to any drawings, materials, equipments, apparatus, method or other thing in connection with the contract, shall mean that the thing referred to shall receive the approval in writing of the Engineer before being ordered done, provided, used or constructed, as the case may be.

10. Definition of "Engineer."—"The Engineer" shall mean   of the City of   , in the Province of   or such person as may be appointed by him for any particular purpose in connection with the contract

DUTIES OF ENGINEER

11. Engineer to have entire control of work.—The Engineer shall have the general direction and entire control of this contract, and of all the work in connection therewith, and the same shall be carried on and completed to his thorough satisfaction.

12. Engineer may order removal of work, plant or employees of Contractor.—The Engineer may order and enforce the dismissal and removal of any person in the Contractor's employ in connection with this contract, because of insubordination or other misconduct, negligence or incapacity, and may also order and enforce the removal of any work or plant which to him appears defective or unsuitable, and the Contractor shall obey such order, and substitute approved work or plant.

13. Variations in work to be ordered in writing by Engineer.—Alterations of the work, so as to increase, decrease, amend, curtail, or vary it, shall be made only on written order of the Engineer.

14. Extensions of time of completion.—The Engineer may in writing advance the date of the completion of the work for reasons that appear to him sufficient.

15. Engineer's decision to be in writing.—The Engineer shall, if the Purchaser or the Contractor so request, give in writing his decision on all matters which may be submitted to him for decision.

16. Engineer's decisions to be final.—Subject only to the right of arbitration reserved in Clause 53 herein, the Engineer's decisions shall be final and binding on the Purchaser and the Contractor.

17. Engineer's certificates required for payments.—No payments by the Purchaser to the Contractor, or vice versa, shall be made unless the certificate of the Engineer shall have been previously given.

CERTIFICATES AND PAYMENT

18. Progress certificates.—Progress certificates shall be issued by the Engineer from time to time during the continuance of the work.

Progress certificates or payments thereon shall not relieve the Contractor of any of his obligations under the contract.

Progress certificates or payments thereon shall not prejudice the rights of the Purchaser against the Contractor, or vice versa.

Progress certificates or payments thereon shall not be construed as final acceptance of the work.

Progress certificates shall be deemed as approximate only, and no certificate but the final one shall be considered as accurate or binding.

19. Contractor may stop work if Purchaser does not pay certified amount.—Should the Purchaser not pay the Contractor the amount set forth in any of the Engineer's certificates, the Contractor may, after giving the Purchaser two weeks' notice of his intention to do so, stop the work. Such stoppage, however, shall not invalidate the contract.

20. Engineer may amend previous certificates, and for cause change contract price.—Should the Engineer consider it necessary, he may by any certificate, correct or modify any certificate previously issued by him. He may also change the contract price by such an amount as in his opinion is fair to both Purchaser and Contractor to cover increases, decreases, amendments, omissions and variations in or to the work, and subject to the contract for damages, losses and injuries suffered by Purchaser or Contractor.

21. Contractor to pay Purchaser amounts due.—Any expenses, costs and damages which are chargeable to the Contractor and which the Purchaser may have paid, or be liable to pay, or which may have become forfeited to him, shall be paid to the Purchaser by the Contractor on the Engineer's certificate, or shall be deducted by a certificate of the Engineer from amounts due or to become due to the Contractor.

22. Final certificate of Engineer.—After satisfactory tests of the work as a whole, and after the completion of the specified term, if any, of operation of the work after its completion, and when the Engineer is of the opinion that the work has been completed in a satisfactory manner, and that all claims, liens, and so forth, have been satisfactorily disposed of, he shall issue to the Purchaser and to the Contractor his final certificate, setting forth his acceptance of the work and the amount remaining to be paid to the Contractor, and thereupon the contract shall be considered as having been completed and the work accepted by the Purchaser. Nothing contained in the final certificate, however, shall be construed as relieving the Contractor of his guarantees as set forth herein against defects in the work, and his obligations covering infringements of protected rights, and claims and damages

PLANS AND DRAWINGS

23. Furnished drawings.—Before any work is done, the Contractor shall, if required, furnish the Engineer with full sets of his working drawings and specifications for the proposed works, and thereafter with all detail drawings and specifications issued from time to time by him as the work proceeds, further setting forth or explaining the details thereof.

24. Further details.—The Engineer may from time to time, as the work proceeds, issue such detail drawings or specifications as are necessary further setting forth or explaining the contract, and these shall be considered by the Contractor in the same manner as the drawings and specifications of the contract.

25. Further drawings.—Should the Purchaser, after the work is completed, require drawings and specifications of the work as built, or any part thereof, the Contractor shall furnish these to the number required at the actual cost of production.

26. Approval of drawings.—All drawings and specifications, whether contract or detail, issued by the Contractor, must, before work is commenced, be signed by him, "Approved for Construction," and forwarded to the Engineer for his approval, upon which "Approved" being written thereon by the Engineer, these shall be deemed to be contract papers and shall not be departed from without the written authority of the Engineer.

27. Meaning of approval.—Approval of Contractor's drawings or specifications by the Engineer shall not relieve the Contractor from mistakes therein nor from his responsibility under the Contract, for the construction or performance of the work, nor for any costs, damages or expenses which may be sustained or incurred by either party by reason of such mistake.

28. Promptness in providing templets, etc.—All drawings, specifications and templets, and especially those necessary to permit the completion of the buildings and structures for the Contractor's work or to allow of other contracts being let, must be furnished with the greatest promptness by the Contractor, to the end that the Purchaser's work as a whole may be carried on in the most rapid and continuous way.

29. Relation of drawings to specifications.—Regard must be had to the drawings as well as to specifications. Anything mentioned in the specifications and not shown on the drawings, as well as anything set out in the drawings and not mentioned in the specifications, must nevertheless be performed in the spirit as well as the letter, and to the true intent and meaning thereof. Wherever any contradiction occurs between the specifications or drawings of the Engineer and those of the Contractor, the specifications and drawings of the Engineer shall prevail.

CLAIMS FOR EXTRA WORK—CARRYING ON WORK

30. Claims for extras not allowed unless ordered and certified by Engineer.—No claims for extra work shall be considered or allowed unless the written consent of the Engineer, setting forth such work and the payment to be made therefor, shall have been given before its commencement.

31. Engineer's permission required before shipping anything to site.—Permission in writing, stating that the Purchaser is ready to take delivery, shall be obtained by the Contractor from the Engineer before the forwarding of anything to the site.

32. Contractor to co-operate with others to expedite all work.—The Contractor shall so perform and arrange his work and store and use his plant, together or alternately, with other Contractors and the Purchaser, that the work of the Purchaser as a whole will be expedited and economically performed to the best advantage.

33. Necessary structures to be ready for Contractor.—Any building, foundation or structure which may be necessary for the proper performance of the Contractor's work or plant, and which is to be prepared by another person not the Contractor, shall be in a condition suitable for the reception and installation of the work or plant of the Contractor before he shall be called upon to do work in connection therewith.

34. Contractor not to sub-let work.—Unless with the approval of the Engineer, the Contractor shall not sub-let or assign the contract or any of the work other than raw materials, minor details or parts, the makers of which are set forth in the contract.

35. Contractor to employ Superintendent.—Throughout the performance of the work the Contractor shall employ at least one competent superintendent, who shall remain constantly on the site during working hours to superintend the work, and who shall be the Contractor's representative to receive and carry out orders and instructions from the Engineer.

36. Purchaser may use work in progress.—All work in progress shall be available for the use and subject to the control of the Purchaser for its intended purpose, provided such control or use does not interfere with nor delay the work of the Contractor.

37. Contractor to conform to regulations of authorities.—Throughout everything pertaining to or in connection with the performance of this contract, the Contractor shall immediately and effectually conform to all the requirements of any authority and government, whether local, municipal, provincial or federal, in whose district the work may be performed, and he shall promptly take all the necessary steps to provide for the due safety and convenience of the public

38. Contractor to clean up site and work.—Before receiving the final certificate of the Engineer, and after the completion of the work, the Contractor shall thoroughly clean up from the work and the site all rubbish and dirt which may have accumulated during the performance of the work. He shall also remove from the site all of his plant [illegible] leave both site and work in a neat and orderly [illegible]

39. Completion required by specified date.—The Contractor understands and agrees that time is [illegible] important and essential part of this contract, and agrees to pay to the Purchaser without controversy as liquidated damages the sum set forth in the form of agreement, should the Contractor fail to complete the work and have the same ready for beneficial use by the Purchaser on or before the date set forth in the form of agreement or such other date as may be set in writing by the Engineer.

CONTRACTOR'S RESPONSIBILITY

40. Contractor to take precautions to prevent accident and to be responsible therefor.—The Contractor shall throughout the contract take every precaution to prevent accident or injury to or by his work or plant. He shall be responsible and liable for all damages, losses, accidents and injuries which may be caused whatever, to or by his work or plant or employees from any cause whatever, other than the act of neglect of the Purchaser.

41. Contractor responsible after completion of work for defects therein.—The Contractor shall be responsible for all defects which may develop in the work under normal use during a period of   months after the date of the Engineer's final certificate. He shall immediately remedy such defects free of charge when the Engineer shall have given him notice to do so. He shall also be liable for all damages caused by such defects.

42. Contractor to defend all actions in connection with the work.—The Contractor shall indemnify and protect the Purchaser against any or all actions, claims, suits, demands, injunctions, costs, expenses and damages at any time in connection with or arising out of the work and the contract. Should any such be made or brought against the Purchaser in connection therewith the Contractor shall at once be notified thereof, and he shall immediately proceed, at his own sole expense, to conduct all negotiations for the settlement thereof of or any litigation arising therefrom. The Purchaser shall, if deemed necessary by the Engineer, give the Contractor all necessary assistance at the expense of the Contractor.

43. Contractor may for good cause have time of completion extended but may not claim damages for delay.—In case of delay in completing the work, due to extreme and extraordinary inclemency of the weather, strikes, lockouts, "force majeure," the act of God, mobs, the King's enemies, or the action or neglect of any other Contractor or the Purchaser, the Engineer may at his discretion allow a reasonable extension of time to the Contractor for the completion of the work. Such extension shall only be granted provided the Contractor shall have given to the Engineer, previous to the agreed completion date, written notice setting forth delay and his claim thereon. The Contractor shall not claim nor be entitled to any damages or reimbursements whatever for delays from any cause during the performance of the work.

44. Engineer to have right to test and inspect work at Contractor's expense.—The Engineer may at any time test and inspect on the site, at the premises or factory of the Contractor or elsewhere, as may seem to him to be best, the work and plant of the Contractor. For such tests and inspections the Contractor shall, unless otherwise definitely specified, provide free of charge all such instruments, apparatus, materials, supplies, labor and facilities as the Engineer may desire to enable him to make such tests and inspections.

45. Defective work to be rejected.—Should any such tests and inspections show, in the opinion of the Engineer, that the design, material or workmanship of the work or plant is imperfect, unsound, defective or unsuited to the requirements of the Purchaser in accordance with the contract, such work or plant may at once be rejected by the Engineer, in which event the Purchaser may do one of the three following things:—

(a) He may permit the Contractor to replace such work or plant with new. Such new work or plant shall conform to the contract in every respect, and shall be performed or supplied immediately by the Contractor

(b) He may himself replace such work or plant with new by any means he may desire and to his satisfaction. The cost of such replacement shall be ascertained and deducted from any balance due the Contractor, who shall reimburse the Purchaser to the amount of such excess, as shown by a certificate of the Engineer.

(c) He may remove such work and recover any amounts paid on account for it, together with the costs of such removal.

46. Purchaser may use defective work until replaced.—Should the Purchaser require to make use of defective work until it be replaced by new, he may do so at the Contractor's risk and expense.

47. Contractor to pay for additional tests.—Should the work fail to pass the first test or inspection, the Contractor shall pay all fees and expenses of the Engineer in connection with making any additional tests and inspections of the same work. He shall also be liable for all losses and expenditures of the Purchaser by reason of such failure.

CONTRACTOR IN DEFAULT

48. Default of Contractor.—The Contractor shall be in default if, in the Engineer's opinion, he fail to show good faith or due diligence in carrying out the contract or any of its provisions, if he go into liquidation, if he become bankrupt or insolvent, if he commit any act of bankruptcy, if he compound or offer to do so with his creditors, if he have a receivership order made out against him, if he permit any execution to be levied against his property, if he carry on business under a receiver or inspector for the benefit of his creditors, or if he assign or sub-let his contract without the Engineer's written consent.

49. Remedies for default.—Should the Engineer state in writing to the Purchaser that the Contractor is in default the Purchaser may do one of the three following things:—

(a) He may suspend action on the default and permit the Contractor to proceed with the work under the contract.

(b) He may at any time take possession of the Contractor's work and plant and proceed with the work in any way he may desire, in which event the cost of such work shall be ascertained and deducted from any balance due the Contractor before further payments are made by the Purchaser to him. Should the cost of such work exceed the balance due the Contractor, he shall reimburse the Purchaser to the amount of such excess, as shown by a certificate of the Engineer.

(c) He may cancel the contract, in which event the amount to be paid by the Purchaser to the Contractor, or vice versa, shall be set forth in the final certificate of the Engineer to be thereupon issued.

50. Contractor's plant may be used or sold by Purchaser in case of default.—The plant of the Contractor shall be considered as being the property of the Purchaser throughout the contract, and in case of the Contractor's default may be used by the Purchaser to perform the work or be sold by him to cover his losses, damages, expenses, costs, and injuries. No plant shall be removed from the site without the written consent of the Engineer.

MISCELLANEOUS

51. Patent rights.—The Contractor shall be responsible for all payments and royalties of whatever nature in connection with any patent, trade mark, copyright, registered name, or other right protected by any authority in respect of any work, plant, system, method, arangement or other thing whatsoever in connection with or arising out of the contract and the necessary allowance for all such work shall be included as part of the contract price. The Contractor shall make all payments in this connection to such persons to whom they may be or become due and payable in such manner and at such times as may be necessary. He shall also protect, reimburse, indemnify and save harmless the Purchaser from or against any claim, demand, action, injunction, suit, costs, damages and expenses at any time in connection with, arising from, or incurred in any infringement or alleged infringement of such right.

52. Notices.—Any notices intended for the Purchaser shall be sufficiently authenticated if signed by the Engineer or by the Contractor.

Any notice intended for the Contractor shall be sufficiently authenticated if signed by the Engineer or by the Purchaser.

Any notice shall be onsidered as having been duly served on the person intended if delivered to him in person, or mailed to him in the ordinary way, postage prepaid, and addressed to his place of business, or as set forth in the form of contract.

53. Arbitration.—When the final acceptance and certificate of the Engineer shall have been given, any disputes as to claims for extras or deductions made by the Purchaser or the Contractor shall be referred in writing to three arbitrators, who shall have full power to jointly make such examinations and inquiries as they may deem necessary to enable them to arrive at a decision.

One arbitrator shall be appointed by the Purchaser, another by the Contractor, and the third by the two so appointed. The arbitration proceedings shall be conducted with all possible despatch.

The decision and award of such arbitrators, or of any two of them, shall be final and binding on the Purchaser and the Contractor.

The matters submitted for decision of the arbitrators shall be in writing, signed and sealed by Purchaser and Contractor, and the award and decision of the arbitrators shall be in writing and signed and sealed by them or any two of them.

The fees of the arbitrators and the other costs of the arbitration shall be paid by the person or persons against whom such fees and costs are adjudged by the arbitrators in their award and decision.

54.—The signing of the contract shall be construed as proof that the Contractor has examined the site of the work and all means of communication therewith, also that he has examined all conditions and is satisfied with them.

Large Expenditures on Quebec Roads

The following statement shows the expenditure of the Quebec Government and municipalities under the Good Roads Act, to 31st December last:

Payments to Municipalities to date	$6,230,658.96
Payments on Government roads to date	2,179,769.28
Total payments to date	$8,410,428.24
New Proceeds of loans	5,850,805.32
Excess of payments over proceeds of loans ...	$2,559,622.92
Amount allocated to the Municipalities to date	$7,595,451.93
Amount paid on same	6,230,658.96
Balance to be paid as work progresses	$1,364,792.97

The Hon. W. G. Mitchell, Provincial Treasurer, in his Budget statement said the municipalities of the province had taken advantage of the Good Roads' Act to such an extent that it would be necessary during the present session to introduce legislation to authorize the borrowing of additional monies for the purpose of continuing the improvement of roads throughout the Province. Since the beginning of the fiscal year 1909-10, $10,293,764 had been spent on improving roads throughout the province, and he was sure that the people of the province would approve of the Government being so authorized to borrow such further sums as it might be deemed advisable and necessary for the purposes of good roads, as they not only benefited people in the rural districts but also those living in the cities.

Following the Budget speech, it is announced that the Government will ask authority to obtain an additional loan of ten million dollars, thus following up the vigorous policy inaugurated by the Ministers two years ago. The money to be raised will be applied partly to loans to municipalities, who will be charged two per cent. for a period of 41 years, while the balance will be spent on Government roads, which will greatly improve the means of communication to the United States. Under the original act the interest was not to exceed 4 per cent. on the loan, half of which was payable by the municipalities; it is probable that the new loan will cost more, but the Government will bear all interest charges beyond the two per cent. specified, in addition to the sinking fund charges.

The Government have received a large number of applications for grants, and with the fresh money to be raised there should be soon a much-needed improvement in the provincial roads. Last year 196.68 miles of gravelled roads and 550 miles of macadamized roads were made, 7,500 men being employed during four months of the year.

A bulletin received from the Herbert Morris Crane & Hoist Company, Limited, Toronto, describes and illustrates the Morris belt-driven friction hoists. It is applied easily, and seldom requires special construction for its erection. It can be driven either from an existing line-shaft or by means of a special engine or motor. Lifting and lowering are controlled by the same handle, and the brake is automatic.

It's a Long, Long Run to St. Helena

Billy had a notion, he could make the Nations
dance;
First he'd slaughter Belgium, then he'd tackle
sunny France;
England was so little, and her army was so small,
He'd simply o'er the Channel cross and watch
the Kingdom fall.

"It's a long run to St. Helena,
It's a long way by sea;
It's a long run to St. Helena,
To the place prepared for me.
Good-bye scraps of paper, Farewell Europe fair,
It's a long, long run to St. Helena,
But I'll soon be there."

Russia may be mighty, and her Cossacks may be
tall;
Billy was undaunted, he could easily lick them all
Paris, Calais, Dover, in their turn would bite the
ground,
While over in Old England, he would surely then
be crowned.

It was little Belgium put the kink in Billy's pride;
France and England held the day, while Russia
got her stride.
Billy got excited when he couldn't reach the sea;
And shouted, "It's the world that's bad, don't lay
the blame on me." —M. S. Logan

The Thirteenth Annual Convention of the Canadian National Clay Products Association

(Staff Article)

THE 1915 convention of the Canadian National Clay Products Association was held last week in the King Edward Hotel, Toronto. The deliberations of the convention were spread over three days, commencing January 26 and concluding on the evening of the 28th. The event, which is the thirteenth annual convention under the auspices of the Association, was in many respects a record. The attendance on the second and third days was about 200, delegates being present from Montreal, Hamilton, London, Sherbrooke, Brockville, Steelton, Arnprior, North Bay, Plymouth, Chatham, etc., while many affiliated members from the United States were also in attendance. The papers read were of a very high order, and their essentially practical character reflected credit not alone upon the individual contributors but also on the brick industry.

The new President of the Canadian National Clay Products Association—Mr. J. E. Frid, of Hamilton.

Mr. Charles A. Millar, Toronto, retiring President, who presided throughout the convention, addressed the members, emphasizing the fact that, notwithstanding interruption in the building trades, occasioned by the war, the various branches of the Clay Products Association had endeavored to keep the wheels of commerce turning.

The convention was given an official welcome to the city by the Mayor, Mr. T. L. Church, who discussed, in a brief speech, the importance of the Association in its relation to the building interests. Mr. Joseph E. Russell, M.P.P., replied on behalf of the delegates. delegates.

The election of officers for the ensuing year resulted as follows: President—Mr. J. E. Frid, Hamilton; Vice-Presidents—Mr. A. F. Greaves-Walker, Toronto; Mr. Thomas Kennedy, Swansea; Mr. William Burgess, Toronto. Secretary-Treasurer—Mr. Gordon Keith, Toronto. Councillors—Mr. C. B. Lewis, Milton; Mr. D. A. Lochrie, Toronto; Mr. W. McCredie, Lyons, Ont.; Mr. Angus German, Toronto; and Mr. John S. McCannell, Milton.

The Secretary-Treasurer, Mr. Keith, presented the annual report, which disclosed most encouraging details regarding the financial status of the Association. This concluded the session and those attending the convention, with their lady friends, were guests of Mr. Daniel A. Lochrie, proprietor of the Park Theatre, who provided special moving pictures descriptive of the various phases of brick construction.

Wednesday's Session

At the morning session on Wednesday, Mr. Andrew Kruson, New York City School of Ceramics and Clay-working, of Alfred, N.Y., read a most instructive paper on "Cheap Glazes for Use on Ontario Clays and Shales." He gave the results of analyses of tests conducted with various enamels and supplied interesting formulas for the successful treatment of enamels. The paper evoked an interesting discussion, in which Mr. Joseph Keele, Dominion Geological Survey, took part. The chairman described the contribution as one of the most comprehensive to which he had ever listened at any convention. Mr. Kruson had given them the formulas so that they could go right into the enamelling business if they so desired.

TORONTO TECHNICAL SCHOOLS AND THE MANUFACTURE OF CLAY PRODUCTS

Dr. A. C. McKay, Principal of Toronto Technical Schools, contributed an interesting address on "Toronto Technical Schools and Their Relation to the Manufacture of Clay Products." The principal theme of his address was the new Central Technical School for Toronto, now almost completed, at an expenditure of about $2,000,000. This sum, he pointed out, was not too great when they considered the industrial interests of the community. They had often been told in the past that Canada was a great agricultural country. That was true, but Canada was a still greater manufacturing country at the present time. The President of the Board of Trade had stated in public, two years ago, that the volume of manufactured products of the Dominion exceeded by far all that we obtained from the forests, the mines and the fields of this country. And yet, until now, nothing definite had been done to up-build the industrial section of the community in an educational sense. Toronto was doing practically one-fifth of the manufacturing of the Dominion and the vast majority of its population were engaged in industrial pursuits. The output of Winnipeg was also very large, but that was due greatly to the manufacture of wheat. On the other hand, Toronto had a great range of industrial workers and they needed industrial education of a special kind. Their aim was to provide facilities for industrial education in all branch Technical Schools in Toronto, in addition to the Central School, in order that the training of the boy might begin at the age of thirteen or thereabouts, the course to be spread over four years. The first two years would embrace a general educational course, the last two years to consist of work in the particular trade which had been selected for the boy. With this object in view, they had provided seven shops, which were shops in the true sense of the word, especially with reference to size. These shops made provision for the practice of brick-making, carpenter work, electrical work, and other trades associated with the building industry. The prosperity of Toronto depended upon its industrial work and not upon the success of its brokers, doctors or other professional men. Arrangements had already been made for part-time and special half-day classes to be given two days a week, to meet the needs of the industrial worker. At the present time nearly three thousand people were in attendance at the evening classes of the Technical Schools of the city and of these, five hundred would be those who were engaged in the building construction trades, at least to some extent. He expressed the hope that the manufacturers would be good enough to permit their employees, without financial loss, to avail themselves of this special instruction. In that event he believed a great deal could be done for the clay-worker.

Discussing the proposed course in Ceramics, Dr. McKay said he had already had the advice and hoped to have the assistance of the Toronto Clay Products Association in the establishing of a course in Ceramics in the revised curriculum of the Toronto Technical School. He hoped also to make accommodation in the branch schools for a similar course. In the new Central School they had a brick laboratory, 60 ft. long by 28 ft. wide, and in that room they proposed to carry on the manufacture of brick and to have in operation the machinery as required in the brick and tile industries. In the same room they also proposed to give instruction in brick-laying and tile-laying. In another part of the building they had a complete ceramic laboratory, which was being donated by the Brick and Clay Products Association. Dr. McKay also referred to the tall chimney, with special flues, which had been provided in connection with the plant for the burning of clay products. In that room they proposed to burn brick and tile and also manufacture terra cotta. Under these courses, certain results would be expected, one of which was improvement in the general education of the clay products worker. They proposed to teach brick-laying as an art and if they could do something towards improving the appearance of the product, that, he thought, would be of benefit to the clay products industry. Toronto was a beautiful city, of which they were all proud. It was a brick city, too, and its beauty as such was due to the product that had been used in construction work as much as to the architectural treatment of that product. Therefore he thought that their school could do much to improve the architectural possibilities of the product.

Reviewing the possibilities of improving the quality of brick, Dr. McKay asked was it necessary that the best kind of paving brick, for example, should be imported into Canada? Was it necessary that the roofing tile in the new Government House should have been imported? He thought there was roofing tile manufactured in Canada that could be used for such purpose; if not, it was up to the manufacturer to see that those products were manufactured within the country. If it was necessary to do so, they could import the raw material, but the finished product should be manufactured in this country. Concluding a very interesting address, Dr. McKay said the beauty of Toronto was due to the excellent products that had been produced in this community. Notwithstanding this great war, many of them were optimistic enough to believe that before very long the population of Toronto would approach a million; therefore a great deal of building would have to be done and much re-building carried out as well, and if they were going to maintain their place in the world, it was up to the Clay Products Association to encourage the work they were undertaking to do in connection with Industrial Education at the Toronto Technical Schools.

An interesting discussion followed Dr. McKay's address.

"HOW I FOUND TORONTO BRICK"

From the viewpoint of the constructional industries, the most important contribution to the afternoon session was the address delivered by Mr. W. W. Pearse, City Architect and Superintendent of Buildings for the City of Toronto, his subject being, "How I Found Toronto Brick." Mr. Pearse, who is a civil engineer of note, has had an extensive experience as an architect, both in Canada and the United States, and his remarks were listened to with the closest attention. At the outset, Mr. Pearse, who spoke from the engineering viewpoint, said that owing to the short time he had been in Toronto and the limited opportunities he had had to study Canadian brick, he did not care to say anything from personal data or personal knowledge. He referred to the various building by-laws in existence in the United States, including New York, Boston, Philadelphia and Rochester, stating he found some very peculiar differences between the by-laws of Toronto and those of American cities. In these United States cities they allowed a load of eighteen tons to the square foot on ordinary brick work laid on cement mortar, and a load of eight tons to the square foot on brick work laid on lime mortar. Referring to the Toronto code of by-laws he said he found that for ordinary kiln-run brick the allowance per square foot, if laid on cement mortar, was six tons, and four tons per square foot if laid on lime mortar. By referring again to the by-law, they found that the law allowed a pressure of eight tons to the square foot on hard gravel and four tons to the square foot on sand and dry clay; thus by comparing these different pressures they discovered some startling results. In other words, they found that Toronto brick, although supposed to be good clay and supposed to be burnt, apparently was not as good as the earth from which it was taken. The conclusion to be drawn from this comparison was that either the quality of the

Retiring President, Mr. Chas. A. Millar.

brick was very poor, or else the by-laws required revision. He pointed out, however, that upon a personal inspection of one of the brick manufacturer's plants in Canada, he was agreeably surprised to find such a high-class brick being manufactured, and the revelation certainly did not warrant any such comparison with our United States competitors. To determine where the fault lay, he suggested that the brick manufacturers of Canada should co-operate and submit samples of the product so that these could be tested and the proper bearing load determined. An important point made by the speaker was that of variation in the quality of brick. For example: one brick manufacturer would probably be careless and produce a poor grade of brick. Under these circumstances it did not seem fair to him that the goo dmanufacturer should be penalized—in other words, be lowered by the by-law to the same level as the careless manufacturer who produced the poor product. It was the fault of the building code that good brick was not given the benefit of good brick. He favored the idea of having something in the nature of a museum for the purpose of tabulating the different grades of brick. He was engaged at the present time in revising the building by-laws of Toronto and before this work was completed, he would like to have an elaborate test made of the brick used in construction work in the city. To this end he requested the hearty co-operation of the brick manufacturers and their assistance in every way. He would be very pleased indeed to have them form a committee, or something of that nature, to see that the proper test of the product was carried out. The present appeared to him a most appropriate time, seeing that a revision of the building by-laws was being made. In conclusion, Mr. Pearse explained that he would like to see the brick manufacturers get justice, as brick is a very important commodity in the building industry.

The cordial thanks of the convention were appropriately conveyed by the chairman to Mr. Pearse for his instructive address.

Other papers read during the session were "The Standardization of Clay Products from an Architect's Point of View," by Mr. Philip W. Greene, B.A.Sc., A. M. Can. Soc. E., Architectural Engineer of the Sun Brick Company. The paper was a most instructive contribution to the literature of the convention and will be published in an early issue of the Contract Record.

Another paper, which was described as the most comprehensive paper on that subject ever read before a convention of the Association, was contributed by Mr. A. F. Greaves-Walker, the subject being "Kiln Kinks."

"Why a Sewer Ought to be Built of Clay Products," was the title of a very instructive paper, read by Mr. George Frid, of the George Frid Brick Company.

Mr. William Burgess, of the Don Valley Brick Works, Toronto, spoke on the "Burning of Clay Products," his paper, which bore evidence of careful preparation and wide practical knowledge, being received very appreciatively by those present.

In the evening the visitors of the convention were the guests of the Toronto Entertainment Committee in a theatre party at Shea's Theatre.

THURSDAY

The convention was resumed on Thursday morning in the presence of a large audience. The papers read and discussed were "The Making and Burning of Clay Drain Tile," by Mr. W. W. Smith, Clay Products Manufacturer, Shallow Lake, Ont.; "Concrete Suggestions for Promoting the Use of Clay Products," by Mr. J. P. Armer, Manager of the Canadian Clayworker; "Under-drainage," by Mr. George E. Fisher, Ceramic Engineer, Dominion Sewer Pipe Company, Aldershot; "Plant and Products of Government Brick and Tile Plant at Mimico, Ont." by Mr. Gordon Keith; "Possibility of Manufacturing High-Grade Paving Blocks in Ontario," by Mr. E. W. Knapp, Superintendent, Sun Briik Co.; "Steam Shovels for Handling Shale and Clay," by Mr. John S. McCannell, President Milton Pressed Brick Company. The discussion was taken part in by Prof. W. H. Day, of the Ontario Agricultural College, Guelph, who contributed a most instructive address dealing with under-drainage problems.

The convention was brought to a close on Thursday evening with the annual banquet, which was held at the Prince George Hotel.

The Use of Gypsum for Fire Protection

Preparation of Plasters and their Advantageous Characteristics

By Virgil G. Marani

GYPSUM, or calcium sulphate, is mined or quarried in the same manner as coal, salt and other similar minerals, delivered to the manufacturing plant, and broken to a size that closely resembles mine-run coal. At the mill it is put through rotary crushers which reduce it to hickory nut size. It is then passed through a cylindrical dryer which removes free moisture and puts the gypsum in condition for fine grinding; then reduced by buhr stones or roller mills to a fineness of about 75 per cent. through a 100 mesh screen; then introduced into a calcining kettle which contains about 15 tons of raw material to the charge.

The kettle furnace temperature reaches a maximum of about 2,000 degrees. The temperature of the gypsum inside the kettle is held about 212 degrees, the material boiling freely; this temperature rises slowly as the process of calcination progresses, until at the end of about two hours, it reaches 320 degrees. The violent boiling then ceases and the mass settles down into a quiescent state, when the calcination is completed.

The charge is drawn off at once through a gate at the bottom of the kettle shell into a receiving pit. Later it is delivered by conveyors and elevators to a bin from which it is drawn for use in the manufacture of gypsum plaster tile, gypsum plaster board, and the many "fireproofing" hard plasters which are used on plaster board or tile or metal lath.

The introduction of fiber in the manufacture of gypsum tile is necessary only to give the tile sufficient strength to facilitate handling through the process of manufacture and shipping. The quantity of fiber averages from four to six per cent. For floor construction and steel protection when gypsum is handled and poured in plastic condition, the introduction of fiber up to 25 per cent. is customary and advantageous to the results as a whole.

There are several varieties of gypsum incombustible lath, the several manufacturers claiming advantages for their own products, but the fact remains that since gypsum is the fire-resisting component, the more gypsum contained in the lath or board, the greater will be its resistance to fire. The plaster board, with which the author is familiar is manufactured in thicknesses of ¼, ⅜ and ½ inch. The sheets are 32 x 36 inches, and are composed of four sheets of wool-felt paper weighing about two pounds, and from 14 to 16 pounds of hydrous gypsum, the weight per square foot of the board being from 2 to 2½ pounds. As no fiber is used, 86 per cent. of this weight is pure gypsum.

In deciding upon any material for fire-resisting construction, the following should be considered among the required conditions:

1. Low conductivity of heat.

This is an important factor and one of the strongest points in favor of gypsum. The calcination report by the National Board of Fire Underwriters showed that in a six-inch block of gypsum, subjected to a temperature of 2,200 degrees Fahrenheit, the temperature at the back face was only 208 degrees Fahrenheit. In other words, only 9½ per cent. of this great heat passed through the six inches of gypsum in four hours.

The reason for this remarkable resistance to heat is due to the chemically combined water of crystallization which, by analysis, is about 20 per cent. by weight. The heat breaks up these crystals and liberates the water, the process being slower as the heat penetrates further into the gypsum. As long as there are any water crystals in the gypsum to be broken up, the material will not warm appreciably above the temperature of boiling water.

2. Low amount of expansion.

There is no appreciable expansion in gypsum when exposed to high degrees of temperature. In the fireproofing of buildings, this is a very important feature, because expansion tends to disrupt or destroy the structure or material by buckling, and in steel frame construction this feature becomes a very serious consideration.

3. Incombustibility.

Gypsum and gypsum plasters are incombustible.

4. Lightness.

Any fireproofing at best is a dead load upon a building and has no part in the support or strength of the structure. Since it is generally conceded that every pound of material added to the weight of a building which is not necessary for strength or stability is detrimental to the structure, the use of the lightest materials for fireproofing should be encouraged, resulting in a saving in the sizes of steel members, the foundations and the cost.

5. Strength.

The Chicago Board of Fire Underwriters' test of June 22, 1910, made at the Chicago laboratories, on 18 full size three-inch gypsum partition tile, selected at random from 50 samples, showed an average crushing strength of 12,603 pounds to the tile, or over an average area of 90.2 square inches, the average crushing strength was 139.7 pounds.

The lateral resistance of gypsum partitions is self evident from the many office and other buildings so equipped. The gypsum mortar used to set the tile, and the gypsum plaster, when set, actually become a monolithic part of the whole. The impact test, conducted at Lewis Institute, in Chicago, shows that when destruction takes place, it is purely localized to the point of impact, the partition as a whole showing no bulging or cracks.

6. Adaptability.

Gypsum is peculiarly adaptable to any form of construction requiring careful fitting and setting. When used in slabs or tile, these are easily sawn or cut to fit any desired location. The same material can be delivered on the work in plaster form, which requires merely to be mixed with water, after which it can be poured into forms like concrete for the construction of monolithic floor, roof system or steel protection.

7. Water effect.

The Underwriters' Chicago tests showed that thoroughly saturated specimens absorbed about nine pounds of water, or 34 per cent. by weight. These saturated tile, when crushed, showed a strength equal to over 33 per cent. of the dry specimen, and when these tile were allowed to dry in the air at ordinary temperatures and then crushed, the average strength compared with tile that had never been soaked was 98.7 per cent., practically a return to the original strength of the material.

8. **Corrosion.**

The Joint Committee on City Departments of New York, of which Prof. Ira H. Woolson is a member, recommended the use of gypsum for steel protection after they had examined the condition of the structural steel in the gypsum slab in the roof of a theater, which had not been in use for over eleven years. They found only slight traces of initial corrosion, located only at the points where the cables bend over the floor beams.

9. **Actual fires.**

The Engineers' building, University of Pennsylvania, which was of mill construction (combustible) with the partitions of three-inch gypsum tile, caught fire at 9.00 p.m., February 6, 1906. These partitions prevented the spread of the fire, saved the library building and remained intact in spite of the volume of water used to quench the conflagration, which was not extingushed until after seven o'clock the following morning.

Saving of property due to gypsum fireproofing can be cited in the case of the Alwyn Court apartment house fire, in New York, on March 4, 1910. This twelve-storey building was saved and the fire confined between gypsum partitions. The interior steel columns, which were protected with two inches of gypsum tile, suffered no damage. The partition faces and decorations in the apartment adjacent to the burning area suffered no damage The temperature of this fire was estimated at 2,200 degrees Fahrenheit.

Lime for water softening is being used in New Orleans, St. Louis, Cincinnati, Columbus, Oberlin, Ohio, McKeesport, Pa., Fargo, N. D., and many smaller cities. Saginaw, Mich., and Cleveland will adopt this form of treatment.

Methods of constructing concrete sidewalks must be employed which will avoid settlement cracks, upheaval by frost, crumbling due to work done in freezing weather, contraction and expansion cracks, separation of top from base, and disintegration.

Loose mortar tops on concrete sidewalks are usually caused by the drying out and the setting-up of the concrete base before the top surface is placed and then failure to take the proper precautions to prepare the concrete surface for the motar top.

Aspects of Town Planning and Housing Reform in Canada[*]

MUCH has been done in Canada in recent years to improve public health and to draw attention to the need for better housing conditions, but there is need for more enquiry and extended effort on the part of all who are interested in conserving human life and raising the standard of public health.

A comparatively new country such as Canada is, has peculiar difficulties to contend with, but it has also peculiar opportunities. It can learn much and derive benefit from the study of conditions in older countries, and at comparatively small expenditure of money it can take steps to prevent the creation of evils which when once created can only be remedied at great cost.

Housing Reform

Most people are acquainted with examples of bad housing and bad sanitary conditions in one form or another. All civilized countries suffer from these conditions, and no measures have been taken to remedy them which can be accepted as suggesting a basis for a council of perfection in regard to what is called housing reform. But in some countries, notably in Great Britain, partial remedies have been found for the evils of bad housing and a high standard of sanitation has been attained. In so far as the attempts to remedy existing bad conditions have been unsuccessful up to the present, it has been largely due to the fact that the bad conditions have been of such a long established character that their removal has to be a matter of gradual change over a long period of time. The change has to take place in the habits and opinions of the people themselves, as well as in the improvement of their housing conditions. In Canada we have allowed some conditions to grow up which are not what they should be, which are, in fact, as bad as they are in older countries, but we have still time to take advantage of the lessons which other countries have to teach us, and it will be well to do so before we allow the community to accept their present unsatisfactory conditions as inevitable or permit those who suffer from them to become habituated to them.

In any case it will be generally agreed that there is room for enquiry into housing and sanitary conditions, and that there is much that should and could be improved, even if the matter is considered solely from the utilitarian point of view.

But apart from the question of remedying evils it is of urgent importance that steps should be taken in this country of rapidly growing urban communities to prevent their recurrence in future.

It can be said with a greater measure of truth with regard to housing than perhaps with regard to any other social question that "prevention is better than cure." What has been done in this latter direction in England points the way to a very real and very substantial success.

Town Planning

Preventive measures in connection with housing evils may all be included under the term "town-planning." As popularly understood in Canada and the United States, town planning does not appear to have much connection with housing, but this is due to an erroneous impression of what town planning is. That may be because the term itself suggests to the mind the mere embellishment of the external features of the town or city, such as the architectural qualities of its buildings or the efficiency of its transportation, and does not convey any idea of the extent to which it enters into the fundamental aspects of city life and growth. Or it may be because the idea of what is meant by the term has been gained from the kind of town planning that has been chiefly prevalent in some countries, such as Germany and the United States, which has concerned itself for the most part with the external and grandiose in city development. But whatever the reason it is an error to assume that town planning concerns itself solely with any one thing connected with improvement of a town either as regards its external appearance, its sanitation or its convenience. In the sense in which it is used in Great Britain and in the sense in which it has lately come to be understood in America it covers everything connected with the city and concerns itself with everything that has to do with the health and well-being of the citizens. In that broad aspect it is really more important than the housing problem, or the sanitary problem, or the transportation problem, since it includes all these and more, and provides the only satisfactory method of studying and dealing with the inter-relation of these problems with one another.

What a Town Planning Scheme May Include

The comprehensive and constructive character of a town-planning scheme in Great Britain will be gathered from the following table of the contents of the Ruislip-Northwood scheme. The scheme deals with an area of 5,900 acres, or over nine square miles, of land lying within the 15-mile radius of the centre of London. It consists of a map or plan and 88 provisions, and, having been approved by Parliament, it can virtually only be altered by its consent.

The map of the scheme fixes the lines and widths of the main arterial roads, the position of all open spaces and parkways, the positions of the residential, shopping and factory areas, and the general layout of the town in all its bearings. It includes provisions with regard to:—

New streets (width, direction, position and how cost is to be met); widening existing streets; adjustment of street boundaries; naming of streets; relaxation of local by-laws; submission of all plans and subdivisions to local authority; minor modification of plan if circumstances change; diversion and stopping up of existing highways where necessary; appropriation at agricultural rates of land for garden allotments, cemeteries and public open spaces; reservation of land for private open spaces, and proper maintenance of same; donation of land by owners to local authority (90 acres) in exchange for certain privileges granted; fixing of building lines on all streets to secure adequate air space, protection of trees, and room for further widening of streets if and when necessary; fixing of proportion of building subdivisions which may be covered by shops (half of area), dwelling houses (third of area) and other buildings; minimum cubic space per person to rooms, minimum window space in proportion to floor area, and limitation of projections from main buildings; limitation of the number of buildings to each acre (a maximum of 12 houses on the average and 20 houses on any one acre is prescribed); height of buildings (maximum 60 ft. to eaves, and in no case higher than width of street); delimitation of areas which may be used for factories, shops and residences; size of living rooms (minimum 500 cubic feet); character of design of buildings; external larders for food—separate closet accommodation for each family—prevention of nuisances in gardens; prohibition of advertisements which interfere with amenity; height of fences; recovery of half of any value which is given to the land by making of the scheme.

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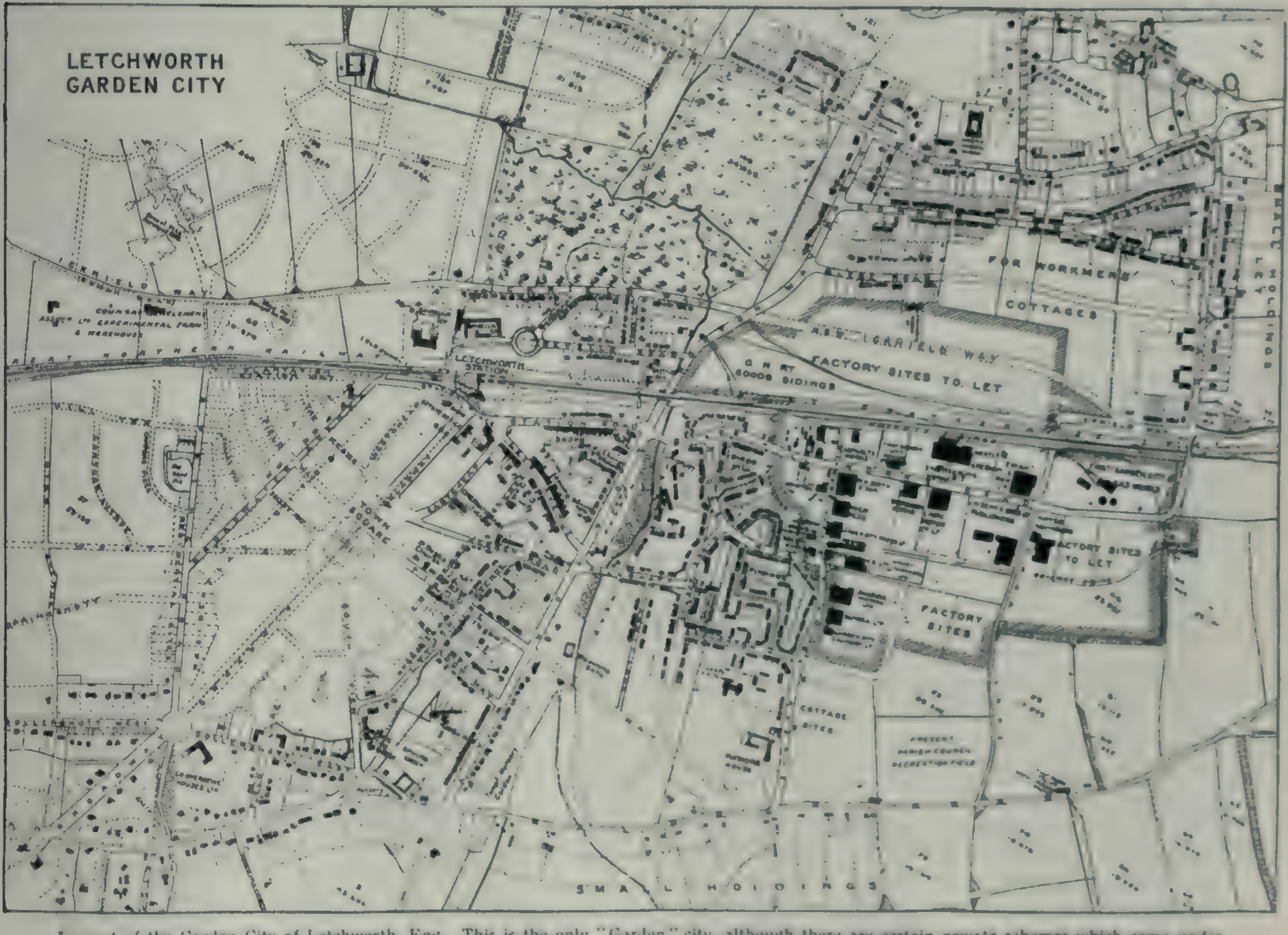
[*] Abstract of an article from the special Town Planning Number of "Conservation of Life," a publication issued under the direction of the Commission of Conservation, Ottawa.

These are some of the matters covered by this one scheme, but their importance is only realized by taking into account the powers given under the scheme to prevent unreasonable claims for compensation. In the first place, during the three years while the scheme was being prepared, no owner could erect any building or enter into a contract which would contravene the proposed scheme. For instance, he could not erect a building on any site without consent of the local authority. Secondly, no claim could be made for damage caused to property by fixing (1) building lines, (2) limiting the number of buildings to each acre, (3) preventing the erection of factories or shops on certain parts of the area, (4) limiting height or prescribing the character of the design of buildings, etc., if the Local Government Board decided that these things were reasonable for the purpose of amenity. Thus no overcrowding is permitted, either in regard to the amount of building on an area or in regard to the number of persons per room, and no person can claim compensation because he is thus restricted.

An important point in connection with this and other schemes in England is that it deals with land in the area of more than one local authority. The Ruislip council, which is preparing the scheme, obtained the consent of the Local Government Board to the inclusion of part of the area under the jurisdiction of the Watford council. With this consent it was able to prepare a scheme in respect of an area which included land outside its own district. Under the scheme, however, as prepared, the Watford council is made responsible for carrying out the scheme for its own part of the area.

The scheme was carried through with the consent of practically all the owners, and it is claimed that the benefits it confers upon them are in excess of any loss they may suffer, notwithstanding that the public health gains immeasurably. Under such conditions slums become almost an impossibility without any cost to the community. The practical effect of the scheme in regard to the housing question is still to be tested, but it may be claimed even now that most of the evils of existing housing conditions will be prevented by its operation.

The cost of preparing the scheme and the maps,



Lay-out of the Garden City of Letchworth, Eng. This is the only "Garden" city, although there are certain private schemes which come under the category of garden suburbs and garden villages. The land for the Letchworth scheme was purchased in 1903. It now comprises about 4,500 acres. Letchworth is some thirty six miles from London. Over twenty factories have been established there, and the population exceeds 8,000. The sanitation is good and the death rate is about 8 per 1,000, as compared with about 15 per 1,000 in Canada, including rural districts.

obtaining the consent of the Local Government Board and Parliament, over a period of three years is given as $5,000. The chairman of the council has stated that seldom has a local authority obtained so much for so little outlay. Its ultimate cost to the council over the next thirty or forty years will probably be about $150,000, but for this it will have obtained advantages of incalculable worth, healthy housing conditions, streets of ample width, 120 acres of public parks, pleasant amenities, security for owners of large residences, preservation of natural features, architectural control, etc. Moreover, it will only have paid for these benefits as the increase of the assessable value of the property provides the local authority with additional resources for that purpose. It may be claimed that the council will gain direct monetary value for all its expenditure without counting the indirect social advantages of the scheme. This is because of the fact that it has used preventive measures under the powers given by the British Parliament in regard to matters which are usually neglected until it is too late to remedy them at reasonable cost. We thus see the supreme advantage of a preventive as distinguished from a remedial scheme.

The present is an appropriate time to proceed with the preliminary work in connection with town planning. This preliminary work can be done by municipalities or specially appointed commissions without waiting for legislation. Some idea of the course which should be pursued may be gathered from the following report, which has been submitted to the Vancouver Civic Committee, with regard to the planning of Greater Vancouver. The suggestions contained in this report are such as are likely to be suitable for application in most populous areas in the Dominion. These suggestions are intended to indicate some of the steps which should be immediately taken by those who are persuaded that town planning is desirable, and who only require some indication of the right course of action to pursue.

Report on the Planning of Greater Vancouver

(By Thomas Adams)

DURING my recent visit to Vancouver I was impressed with the beauty of the site on which your city and the adjacent populous centres are growing up, and with the need which exists for the preparation of a comprehensive plan of the whole area comprised in what may be described as Greater Vancouver.

The site is unique both in regard to natural beauty and business prospects. The populous group of districts, which include Vancouver, Point Grey, New Westminster, N. and S. Vancouver and their environs, is suffering in a special degree from haphazard growth and speculation in real estate, notwithstanding the progress that has taken place in the last few years in regard to the control of sanitary matters and local improvements. There is need for co-operation between the administrative authorities and the chief land and railway interests, for the mutual benefit of all concerned, and principally with a view to securing that Greater Vancouver will enjoy the benefits of wise foresight exercised in proper time.

However excellent separate schemes may be for creating civic and university centres, new harbors, railway terminals, industrial areas and means of transportation, they will all lack the chief quality of a proper city plan if they are not considered in relation to one another and in relation to the general business interests and health of the citizens. Important as are the needs of the immediate present they can only be properly and adequately provided for if consideration is given to their relation to the future growth of the whole area likely to be used for building purposes in the next forty or fifty years. It may be impossible to precisely forecast how any city or group of cities will grow in regard to minor details of development, but it is quite feasible to consider and lay down the main lines along which growth may be directed and so save the taxpayers of the future the heavy expense of remedying evils which are allowed to accumulate as a result of undirected and misdirected growth.

It is insufficient to consider a plan for the city of Vancouver alone, and it is not desirable at the present time to formulate a plan which will involve either Vancouver or any of the adjacent municipalities in any expense which they would not have to incur apart from a plan. But the small cost of having a plan prepared should be faced and there is no time more appropriate than the present. In London, which is more critically situated than any other city in the Empire in connection with the war, plans are now being considered for the future development of an area of nearly 1,000 square miles. No less than 137 administrative authorities are concerned in that area, and all of them are joining in conference to formulate a plan for the main arterial roads of Greater London. What is practicable under such conditions and with so many local authorities should be more practicable and more easy of accomplishment in Vancouver and neighborhood. The small cost of making a preliminary survey as the basis for a comprehensive plan will be fully justified by the immediate results and by enabling the authorities to carry out schemes of local improvement on sound and economic lines. It is a suitable time to give employment in such work and to determine the main features of a plan before building activity is resumed.

What seems to be desirable is to form a Commission to consider the whole question of the future development of Vancouver and the neighboring municipal areas and to suggest, if necessary, new legislation to enable such a plan to be carried out. Such a Commission should be representative of all the authorities having jurisdiction in the area which should be planned, and of the principal railway and real estate interests. Its first duty should be to prepare a topographical map of the area and to make a survey of existing conditions, next to suggest a comprehensive scheme showing the best lines for main arterial roads, desirable railway and harbor improvements, suitable industrial areas, and general provisions for convenience, amenity and proper sanitation. The scheme should not enter into details but merely give the broad outlines.

There are two courses open to us in Canada in connection with the planning of our cities. The first and preferable course is that which has been adopted in Great Britain. It is to secure effective town planning legislation and thereafter to formulate a town planning scheme conforming with the requirements of that legislation. It is essential that the legislation provide machinery for a certain amount of oversight and assistance by a provincial authority, in order to secure practical and effective co-operation between adjacent municipalities, and arbitration on points of difference. It is of the essence of town planning that all municipalities in juxtaposition to one another should co-operate and agree on a harmonious system of development and control, and also that some independent authority should act as arbitrator in those cases where the common good comes into conflict with the interests of property. It follows that in proper town planning it is desirable to have a higher authority than the municipality to ast as a sort of Court of Appeal, and that such authority should be a part of the machinery of the Provincial Government. The necessity of such an authority will only be fully realized when town planning is carried out in practice. Cases occur where the linking up of two districts by main roads is found to be as important as the development of roads within each separate municipal area, and when the ratio of expenditure to be incurred by separate authorities has to be determined. In such cases agreement is generally impossible without appeal to an impartial tribunal free of local interests. It is also essential in connection with town planning to have some general principles settled as to the density of building on land, heights of buildings and selection of residential and industrial areas. For one municipality to settle these for its own area is not enough as its whole scheme may break down owing to the want of similar provisions being applied on the borders outside its area. Hence the need for legislation and a provincial department to make certain important matters of general application and to secure co-operation.

The defect of this suggestion may appear to be that it would interfere with local autonomy, but in practice this is not the result. It is found to be practicable to give a local authority more discretionary power under such circumstances, it links the city management with the provincial management, and it gives added value to the security offered by the city when funds are needed.

However that may be, the initiative in legislation does not rest with the various city authorities, although they might suggest to the Provincial Parliament the need for and the proposed scope of such legislation.

The second course is one which is immediately open to the city and town authorities themselves. It is to voluntarily co-operate with its neighbors in appointing a commission to formulate a scheme. What is meant by a scheme is not merely the presentation of a plan on paper showing the main arterial roads, the desirability of this or that architectural treatment of buildings, and the need for improvement of what might be called the "frills" of the city. These things may be important in their place, but the defect of many schemes is that they only include such matters, and that they usually involve large expenditure of money. This defect frequently arises from the fact that the plan itself and not the scheme for giving it effect is regarded as the essential thing.

In preparing a scheme regard has to be paid to the essential features and functions of the city or group of cities. In the first place, a city is a manufacturing or administrative centre and the first concern of a town plan should be to provide for the proper and efficient carrying on of business. Complementary to the business side of city life is the provision of satisfactory and healthy living conditions for the people. Thus the factory and the home are the two essential and most important considerations in planning the city. Interlaced with these, but always secondary, are the numerous questions relating to transportation, education, recreation and administrative centres. The preparation of the plan or scheme need not involve the municipalities in any expenditure beyond the cost of preparing it. Its chief value to them will be as a guide showing how money can be saved and how, when spending becomes necessary, it can be wisely spent. Much can be secured without cost by agreement and co-operation with owners when both the public authority and the owners have a scheme to follows.

The present condition of each city and town should first be carefully studied and maps and diagrams prepared showing the topography of the area, the traffic conditions and density of population, the location of factory and residential areas, the relations of cost of sites of dwellings and factories to cost of development, and of both items to the assessable values. After that, certain general principles should be determined and a scheme of provisions drawn up to secure effective control of both the built upon and unbuilt upon area. Different provisions will, of course, be necessary for areas already developed and for those not yet built upon. Then, but not till then, should the skeleton plan be prepared illustrating the proposals and as a key to the provisions of the scheme. It is a mistake to draw up a plan and leave the question of a scheme for carrying it out severely alone; it is only when the legal form of a scheme is settled that the practicability of a plan can be realized.

In some other provinces of the Dominion steps are being taken to promote town planning. In Nova Scotia, New Brunswick and Alberta Town Planning Acts have been passed. In Ontario the City and Suburbs Act provides that subdivisions of land in cities of over 50,000 inhabitants must be approved by the Railway and Municipal Board and that they must, as far as possible, conform with a general plan of development. In Saskatchewan there are provincial regulations which require that all roads and surveys must be approved by the Board of Highway Commissioners before they can be registered. In Calgary, Edmonton and other cities comprehensive plans have been prepared, and in Winnipeg a Greater Winnipeg Plan Commission has been at work for some time. A Planning Commission is also preparing a scheme for Greater Ottawa. The Winnipeg Commission is working on an area of 200 square miles with the object of preparing a comprehensive plan. The Commission realizes that before it can make its plans effective it will require to have legislation in Manitoba, but the work it is doing is of great value in enabling its members to judge what legislation is required. No legislation is likely to be effective without the help of the municipalities in first preparing maps of existing conditions and making surveys of their areas, and this is work which can be undertaken to advantage without further delay. The value of having a topographical map prepared may be gathered from reports showing the recent experience of Cincinnati and San Francisco. In Cincinnati it was lately reported that no less than 200 miles of sewers were discovered, as a result of a survey, of which the city had no record. The City Engineer of San Francisco has said that $26,000,000 was the cost of certain improvements which could have been avoided had the planning of the city been adjusted to the topography, and that this was merely a part of the expenditure that would have to be incurred.

From New York City comes word of the death of Col. Davenant Roger, a civil engineer who had been sent to New York by the Canadian Government to observe the construction of the Croton Aqueduct and the syphon under the Hudson River. At one time the late Col. Rogers was Chief Engineer for the Chilean Government. He had played a prominent part in the building of the Canadian Pacific Railway and the Cape Cod Canal and was about to start for Arizona to plan the construction of a large engineering proposition.

Messrs Quinlan & Robertson, of Montreal, who have the contract for the construction of the Bloor Street Viaduct, Toronto, have opened temporary offices in the Traders Bank Building.

The Engineer Out in the World

By Harry Barker

[Discussion of a paper by Mr. Martin Schreiber, published in our last issue.]

IT is possible perhaps to make the statement even stronger about the increasing number of opportunities for certain men of engineering training (considering only times of normal business activity and when there is no wide unsettlement of commercial affairs by war). Courts have long had more or less respect for expert witnesses, but there seems to be more and more reliance on an engineer's determination of facts and more weight to his opinion where facts cannot be demonstrated.

There are commissions (not merely utility-regulation bodies) looking toward flood prevention, fire protection, civic beautification, economical government, etc., that have to rely on fundamental knowledge obtained for them by engineers. Not only are positions "thrown open" requiring economic and technical knowledge, financial, organizing and general business ability, but there is some evidence of a desire to push engineers into such places. This may be due in part to a better appreciation on the part of the thinking public of the results to be secured by an engineer's type of attack of any problem. The success of certain engineers in great pieces of work like the Panama Canal has exerted tremendous influence on the general public in this direction. The tendency may be partly due to the discontent engineers are showing more and more when they see unscientific methods on every hand and sincerely desire to help their communities with their unique training. The tremendous increase in the number of engineers of all kinds in the country has assisted in the common knowledge of the peculiar benefit of such training. The greater numbers have also resulted in more broad minded engineers of large interest and sincere public spirit.

Great stress is laid on the modern tendency toward specialization. While it is true that the great majority of engineers are highly specialized and while practically all engineers in their earlier life follow great specialization, yet any such statement broadly made needs possibly some qualification. It appears that the older established engineers of the country enjoy a practice that gives them a broad range of action, throughout one of the few major divisions which are mentioned. Instances and illustrations might be multiplied but a few will be taken at random; for instance, the late George Westinghouse, who up to the time of his last illness turned his fertile brain on the greatest variety of mechanical problems, started with air brakes, but drifted into steam engines, gas engines, electric power apparatus, steam turbines, speed reduction gears, mechanical substitutes for pneumatic tires, and so on. There was also the late Alfred Noble, a great tunnel and excavating specialist, but in demand on problems of dams, railroads, hydraulic and civil engineering generally. There is John R. Freeman, expert on dams, power developments, hydraulic properties, mill construction and equipment, fire prevention, factory valuation, etc. It was he who made that most unique study of American and foreign university development which has served as the basis of the new Massachusetts Institute of Technology; he originated for them the peculiar connected scheme of structures employed(though a much grander architectural embellishment was substituted for his idea of keeping to severe appearances). There is B. J. Arnold who is best known perhaps for his transportation studies, but who seems to know intimately railroad operation and construction, steam and electric mechanical equipment, and who is the president of a company which undertakes any sort of engineering work.

The definite success which comes to men eminent in the profession must be the result of a definite cause and not a mere accident. They have all come up to their prominent positions, breadth of interest and variety of work through more or less of a specialty. They have succeeded in most cases, there is reason to feel, by diligent effort in mastering their specialty, and in keeping their hold on engineering work as a whole and their interest in problems of general welfare. Can everybody do this? Perhaps only more or less as well. But those who can do it are the ones who will occupy the positions necessarily left vacant by the leaders as they pass beyond. Inborn genius is not essential for there are certain aids at hand in attaining this desired end. Men can so make use of these available means that a mediocre mind under good control will accomplish more than the mind of a genius even unharnessed and left to itself. As wonderful results can be secured by organizing personal mental effort as in the complicated production of a large factory or the maintenance of an extended transportation system. There is not room here to say much about the cultivation of personal efficiency for that in itself is a big subject.

Two of the great instruments in mastering a specialty and retaining a hold on one of the major divisions of engineering and on the engineering field as a whole are: (1) The technical associations and engineering societies, and (2) the technical periodicals. In many cases, the society gives opportunity of intercourse and conference with other men following the same specialty and with leaders in that particular major division. Sometimes there are smaller societies devoted to the specialty. The technical associations are of peculiar help from the diverse interests represented and the wide range of topics discussed though all inside a particular industry. The use of special and broader engineering papers of course does not lead to the intercourse and personal acquaintance, but it does give immediate and timely knowledge of progress being made in a specialty and along broader lines.

Lest the preceding remarks on limitation of specialization should seem too academic, it may be well to note that they may have an important practical bearing. When a man confines his attention entirely to a very limited field it is common experience that along comes some revolutionary change just outside his own specialty and that reduces the demand for his sort of work until he finds himself out of a job wit hnothing to fall back upon.

In a word, specialization is necessary, often extreme specialization, but that should not so absorb a man that he knows nothing else of other engineering, of economics, of nfiance, physics, chemistry, history, civics, industry, human welfare, and so on. This thought seems to be an undercurrent in Mr. Schreiber's paper;

from another point of view it comes forward out of the background into a more prominent position.

Mr. Schreiber modestly refrains from saying much about college courses while others with no more license and less modesty pursue the subject. But all will agree that it is not the curriculum that makes the engineer, for more real engineering is learned outside school than in. What can be done, and what should be in every case, is to impart a certain fundamental knowledge and give a certain peculiar training. **The knowledge** to be secured comprises general science, language, mathematics, mechanics, mechanism, properties of materials, drawing, laboratory procedure, and some very elementary engineering ideas. **The training** is in a habit of thought and a method of securing all possible evidence, impartially weighing it and then proceeding as so dictated to secure a certain end. It is the investigative spirit and the search for relations between cause and effect. It is an aim always to secure a needed end by the most economical route. It has various names. Some call it shortly "the cultivation of the scientific spirit of attack," and perhaps that covers the ground about as well as a more abundant description.

It would clear away misunderstandings, if men who have not had the privileges of a college education would only realize just what it does for the future engineer—for this knowledge and this training is not gained exclusively in school. There is no hidden magic in a college and many a man gets as far without its stamp as his brother with its degree. Of course the pleasant associations are missed, but that is another matter.

Mr. Schreiber does well to introduce vocational guidance, even though he refrains from placing responsibility directly on certain people who should not escape. Not only manufacturers and college professors, but also parents and teachers in the more elementary schools should bear the burden. A great deal of good, of course, can be done by the professional adviser—one skilled in psychology, etc. But it is possible that the more intimate acquaintance which comes to the less skilled and less technical advisers may perhaps secure even better results often—especially if they realize their limitations.

This is somewhat at variance with the apparent ideas of those recognized as leaders in vocational guidance, who rely on well equipped bureaus, etc. However, nothing has been brought to the writer's attention that changes his view (and he has been more or less in touch with the movement since its inception, having made some independent attempts about the time of the pioneer workers). Nothing has developed that has ruled out the parent and teacher, for only the broad classifications of aptitude are possible anyway with schoolboys, and intimate acquaintance and long continued observation offset special training and bureau equipment. The bents themselves are not always sufficiently developed to be recognizable but it will be a great benefit to pick out such budding attributes as will enable one to say with confidence that this boy will probably do better in some literary pursuit than in a scientific, or that the other boy has a combination of inquisitiveness and memory with skill of hand and quickness of mind to make a possible doctor of medicine. It may be possible to go so far as to detect the one who will make an engineering designer and the one who should be a constructor or operator. Real business (buying and selling) ability can be detected. Beyond such generalizations in boys up to 18 years old, there are some doubts about going. But it is well to go so far and direct their studies into channels where greatest success is probable.

Much of the vocational-bureau work is wandering off from the placement of boys in proper fields of life work into seeing that certain working boys do not get into "blind-alley" occupations. This is an economic and socialogical side of the guidance work which, of course, should not be neglected. Its present emphasis is natural since the people who are in the van of the movement seem to be socialogists. There is one great exception, Prof. Hugo Muensterberg, who has contributed most helpfully with his great experience in experimental psychology.

Any such movement as vocational selections, of course, attracts fakers. We hear of people who pretend to great success in securing proper employees for various industries by studying the color of the hair, the length of the ears, the shape of the nose, the tilt of eyebrows and other superficial features. Their mental tests are practically nothing, and their whole schemes savor very much of the old phantasies of phrenology. In fact such work has been specifically and pointedly criticised by real psychologists like Prof. Muensterberg.

No attempt has been made to give these passing comments logical form or arrangement. Nor is there really anything presented beyond what Mr. Schreiber has written about, though many of the ideas are approached from a different point of view and from different experience.

The Ventilation of Industrial Plants

By C. T. Graham-Rogers, M.D., Director, and
William T. Doyle, Mechanical Engineer,
Division of Industrial Hygiene, New
York State Department of Labor

WE have conclusively proven the necessity for constant air changing in industrial establishments, and have noticed beneficial effects upon the workers, also we have shown the necessity for efficient removal of dust, fumes, gases or vapors. The solving of these problems is not merely one of ordinary public health, but also of economics, for there is financial gain in many ways. The employer secures efficiency which enhances his financial returns, the worker secures better health with its financial returns, and the State secures healthier citizens which add to its prosperity.

In the list of papers presented at this convention for discussion, heating, lighting, and ventilating are treated from many specialized viewpoints, and much valuable knowledge and experience have been disseminated; yet in all the list there is not included a treatise on any one phase of industrial ventilation or lighting. Surely the reason is not because this field is not sufficiently extensive to warrant attention; 1,200,000 in this State alone are employed in the field of manufacturing on an average of nine hours each working day, representing a far higher number of man-hours occupancy of work rooms than any class of structures except tenements.

Neither may the omission be attributed to the ideal conditions generally prevalent in factory buildings with regard to the factors under discussion. A very limited examination of conditions will dissipate any idea of this being a fact. In no place other than manufacturing establishments will the ventilation problems present so many complexities and in no other class of structures will the solution thereof be found so primitive, if perchance any attempt at solution has been made. Aside from questions of temperature and air movement, the theatre, school or hospital furnishes no problems. These questions are of as great importance in manufacturing establishments, and in many of them there is added the problem of caring for injurious gases, fumes, vapors and dusts generated by the appliances and materials of manufacture.

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* Paper presented at the recent Annual Meeting of the American Society of Heating and Ventilating Engineers.

In the matter of heating and ventilation of factory buildings the architectural profession is primarily at fault. In designing such structures the craft has been servient to the ideas of production superintendents and has depended on this latter class for guidance in matters of interior arrangement, professional ingenuity being exercised only in minor details aside from the exterior elevations. It has not consulted experts, as a class on the problems of ventilation, heating or lighting, because it has never understood the necessity of doing so, and the existence of the necessity has never been brought home in a way as impressive, to cite an instance, as the necessity of obtaining expert structural advice when the fashion in office buildings changed from the five-storey to the twenty-five storey type. No better evidence is required of the lack of cooperation between architects and ventilating specialists in the design of factory buildings than the absence of a set paper at this conference, relating to the problems peculiar to this class of structure.

It is seldom that a complete set of plans covering the proposed activities to be carried on in the different parts of a factory reaches the State Department of Labor. However, one such set was received not long since, and in checking the exhaust system shown on same, attention was drawn to the fact that there were soldering rooms, lacquering rooms and even buffing rooms in which no provision was made for caring for the fumes or dust generated. The attention of the designing engineer was called to these apparent omissions, and he explained that he had proposed a very comprehensive system of mechanical ventilation throughout the plant, only to have it blue-pencilled indiscriminately by the owner. The indiscriminate pencilling was all too apparent, as refinements had been allowed to remain, whereas essentials were excluded. There is a surprise coming to that owner on the occasion of the first visit to the plant of a department inspector.

It is necessary that an educational campaign be planned and carried to the notice of factory owners. They are generally of the type described by one author as not seeing beyond the penny of today; but who when convinced that better working conditions mean more money to his credit, is your convert. In planning his factory, he has left all the details which he considers unimportant to his architect, depending on the architect to provide facilities of heat, light and ventilation, which he appreciates vaguely, but whose importance he does not understand. It is a duty of great importance to show the architectural brethren, and through them the owners, that expert advice in these matters will repay them many times over, in better workmanship, increased output, decreased time lost per employee through illness, decreased cost of illumination and in numerous other ways. It is a duty to the country to see to it that the next generation and the next after that are not sprung from starvlings, for while we, as a nation, have heretofore had the brawn of Europe from which to draw our manufacturing labor, we may well look to the day in our own land when the conditions so aptly described by Professor Arnold may obtain.

Development in Heating and Ventilating Industrial Buildings*

By E. L. Hogan

THE industrial building of to-day is heated by one of three methods: direct steam; direct hot water; or by forced circulation of air which is heated by heaters, supplied by steam or hot water, and centrally located. The greater number are heated by direct steam because it can be installed by any steam fitter and frequently the superintendent with his millwright and other help can do the work. They know more about this system than any other and are not keen for methods they do not fully understand.

In certain lines of industry where moisture from some drying process or otherwise, must be absorbed by the air within, the blower or hot blast system is most efficient because by means of it the moisture is removed by the circulation of the air that heats the building. Also in buildings where smoke or gases must be removed, the forced circulation is desirable.

In order to study the movement of air currents let us assume a building as illustrated in Fig. 1. This could be used as a foundry, machine shop, car shop, structural steel plant or forge. The side walls are of concrete blocks and glass set in steel sash; the frame work is of steel, the floor of concrete; the roof of reinforced concrete with composition roofing cover.

The natural air currents in the structure would be as indicated by small arrows in the illustration. This movement is caused by the difference in temperature of the air within; that coming in contact with the cold roof, monitors and outside wall becomes cooler and heavier, and consequently falls. The warmer air in contact with the floor rises and circulation is set up tending to equalize the inside and outside temperature.

From a heating standpoint we are interested in a strata covering the lower eight feet of the interior. This must be kept comfortable and fairly uniform. It can be accomplished by creating currents in the upper portion of the building so that no cold air will reach the floor, taking care of the outside walls by radiant heat from radiators placed above and out from the walls, or below and on or near the walls, and taking care of the lower strata of air by heat from the hot strata above. This method is practically keeping the exposed surface of the structure warm so that there will be no cold currents in the working portion.

In structures of this kind where the peak of the roof is 40 feet or 50 feet above the floor and a working temperature of 65 degrees near the floor is maintained, the temperature near the peak will be approximately 90 degrees. While it is apparent that by keeping the exposed surface warm or keeping a layer of warm air next to it, that the inside of the structure will be warm, nevertheless, it would seem as though it would be better to keep the working strata warm and do so in such a way as to prevent the cold currents from entering this strata. This would reduce the temperature of the air in proximity to the cold exposed surface and decrease the heat loss from the building.

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* Paper presented at the recent Annual Meeting of the American Society of Heating and Ventilating Engineers.

In order to produce results like this it would be necessary to continually mix hot air with the air in the working strata in order to maintain a working temperature. In this system the hotter portion of the building is the lower, and the radiant heat is up and toward the exposed surfaces. Air mixes or diffuses very rapidly and sufficient air must be circulated in the lower working strata to maintain a uniform temperature. Such a system is what is aimed at with hot blast and what is frequently obtained. It is surprising how well and with what a little heating surface and consequent small steam consumption you can heat a building in this way.

A distributing system which would approximate these results is indicated on this plate in Fig. 2.

Frequently it is attempted to heat a structure like this with a hot blast system by simply having outlets in the mains and no drop pipes. In this case it would be necessary to direct air toward the outside walls and downward at various angles in order to produce a distribution and the heating would revert to a condition where you would have to warm or produce a layer of warm air next to the radiation system. The exposure in this case would be larger and the usual method of figuring would not suffice.

In figuring the heat losses from a building you should first determine how you are going to heat it and then it will be possible to determine what the difference in temperature may be between the inside and outside of the various parts, such as outside wall, glass, roof, monitors, etc. As it is now, we take the temperature desired and assume that this is the inside temperature all over and with all methods of heating. The heat losses from the building shown in Figs. 1, 2 and 3 would probably be determined as follows: inside temperature, assume 65 degrees; outside temperature, corresponding 0 degrees. Exposures would be as follows: exposed wall surface; exposed wall glass surface; exposed roof; exposed monitor wall; exposed monitor glass; exposed floor.

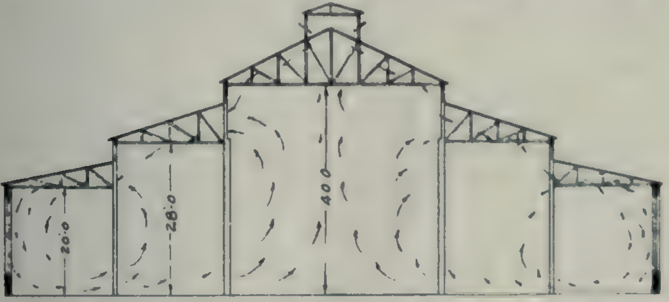

Fig. 1

Using constants for radiation losses our table of losses would be as follows:

Kind of Surface	No. of sq. ft.	Diff. in Temp.	con- stant	Con. x Temp. diff.	Heat loss in B.t.u.
Outside wall	9,040	65	.33	21.45	194,000
Outside glass	10,760	65	1.2	78.	838,000
Outside roof	38,400	65	.3	19.50	711,000
Monitor Wall ...	3,600	65	.4	26.	93,600
Monitor glass ...	4,800	65	1.35	87.8	422,000
Monitor floor	36,000	35	.31	10.85	391,000
					2,649,600

Total heat loss equals ... ... 2,649,600 B.t.u.
Heated day time, only add 10% ... 264,900 B.t.u.
For infiltration of air on windy days add 10% ... ... 264,900 B.t.u.
3,179,400 B.t.u.
Total cubical contents of structure = 1,180,000 cu. ft.

With a condensation of ¼ per sq. ft. of direct radiation, this structure would require 13,200 sq. ft. or 1 sq. ft. for every

With direct radiation placed along the outside walls or suspended from the roof trusses the average temperature between the inside and outside of the exposed surface would be greater, the heat loss approximately 3,663,000, and the radiation required would probably be approximately 15,250 or 1 sq, ft. to 77.4 cu. ft., providing for the same extra 10 per cent. to heat up quickly in the morning where the building is used during the day time only and also for loss due to infiltration of air on windy days.

Now if a hot air system were used with drop pipes so as to distribute the air over the working strata, the average loss from the building would in all probability be approximately 2,680,000 allowing for the same extra amounts under similar conditions. However, to partially offset this, is the loss in temperature of the air due to radiation from the distributing ducts. This amounts to approximately 8 per cent., varying with the shape of building or the extent of the distributing ducts. This would be equivalent to increasing the radiation loss by 8 per cent., which would bring it up to 2,900,000 B.t.u. Thus it would seem that by applying the heat to the area where it is required, we would save approximately 21 per cent. of steam required. This would only be possible with a blower system and with distribution to the strata required as indicated in Fig. 2.

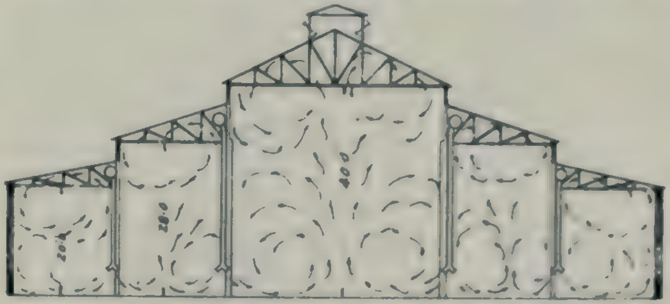

Fig. 2

If the drop pipes or ducts were stopped within 3 feet of the main duct and the air directed out toward the outside walls and down, the problem would become similar to the direct radiation installation and the losses would be between 3,179,400 and 3,663,000 which would be more nearly correct, and in this event the saving due to the use of a properly designed hot blast system would be approximately between 9 per cent. and 21 per cent.

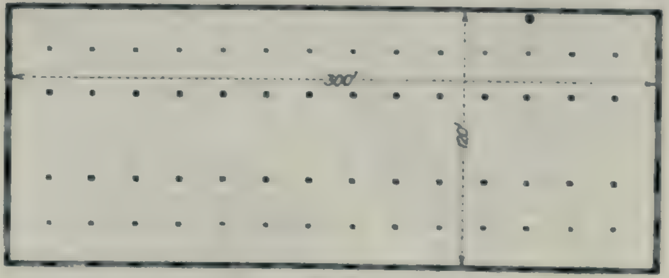

Fig. 3

Owing to the fact that a hot blast system can be overloaded and is also capable of forcing the heat to all parts of a structure under adverse conditions, the average purchaser expects a great deal more from it than from direct radiation and our experience has been that a hot blast system has to do about 20 per cent. better work than would be expected from a direct job. A great deal more is expected of something which is more conspicuous and which has a moving or operating part.

There is one thing which should be kept in mind and that is that as the outside temperature rises and the requirements become less, the temperature of the air or the quantity of the same, may be reduced, and in practice this is done so that the average amount of steam used for a season is much lower than the maximum requirements.

With a direct radiation installation the temperature of the steam cannot be lowered because generally exhaust or low pressure steam is used and hence the only way to cut down the quantity is to cut off certain parts of the radiating surface. This does not distribute the heat as well as before and therefore is not generally done. The method pursued is to open the windows and increase the radiation loss to a point where it will maintain a comfortable temperature and while the average outside temperature is higher than the maximum requirements the quantity of steam is not reduced materially.

Now as regards cost of installations. The design and manner of fan blast application is something that can always be worked out to good advantage though the method of application must necessarily depend upon the character of the building and its uses.

The ordinary industrial building presents the simplest of all problems. As a rule the per capita space for the workmen is large and the heating only is of paramount importance while ventilation is, in a way, incidental. As a rule ventilation can be secured by allowing the fan to draw its air from the building, thereby turning the air over and over, merely adding to the heat necessary to offset the leakage and radiation losses. To this end it is desirable that apparatus be placed as near to the centre of the building as possible so the circulation is nearly uniform from all sides. Such a location very much simplifies the distributing arrangement and materially reduces the cost.

From the apparatus the air is discharged into underground or overhead pipes to get to its proper destination. It follows from the above, however, that the best results are obtained by discharging the heated air near the floor and outward so as to distribute it as nearly uniform as possible. It is usually most convenient to carry the piping overhead in the manner shown in Fig. 2.

The average class of industrial buildings can very often be heated satisfactorily with a limited number of ducts by discharging the air at high velocity and thus compelling it to continue its direction of movement for a considerable distance without the use of conducting pipes. This simple construction must be adapted to the character of the work carried on in the building, extra refinement in the manner of distribution being unnecessary where the workmen are actively employed. However, great care should be used in such a distribution not to have the air currents strike the occupants, as many systems have been condemned for this reason—no fault of the heating but of the distribution.

In other cases, when obstructions interfere, the air can be forced only a short distance and local distribution is necessary. This is common in the ordinary car paint shop. There the air is generally discharged downward toward the floor through pipes extending down between the cars. This not only heats the building but the time of drying is very materially decreased.

A similar problem is the case of a locomotive roundhouse where a blower system can be made to serve a double purpose. The general heating can be accomplished by discharging the air from overhead pipes toward the walls on either side or it may be utilized as a means of rapidly melting the snow and ice from the running gear of the engines by discharging all or a part of the warm air into the pits.

Industrial buildings two storeys and higher can very often be equipped and satisfactorily heated without any distributing pipe connections by having vertical flues built in the walls from which the air is discharged toward the opposite side through openings from 8 to 10 feet above the floor line. These flues and but little to the cost of the building if the same are taken care of in the architectural design.

Whenever the flues can be built in the walls and the distributing ducts are of moderate extent the system will figure less in first cost than any other capable of attaining the same results.

From the standpoint of equivalent results a blower system of heating can be installed at not greater expense and with as much profit to the contractor as a system of direct radiation. It can be overloaded or can be operated as conditions require. In this way the steam consumed is minimum. If motors are used it might cost more to operate the fan but the saving in steam would more than offset this. There is the added advantage that ventilation is possible and where moisture is to be removed there is no comparison, as circulating air is the universal absorbing medium. In many cases, for no greater expense during the year, ventilation and heating can be produced for what heating formerly cost.

One feature of hot blast heating that is particularly apparent to us is that most contractors do not have the confidence in their ability to make the installation a success that they do with direct radiation. As a result, very often direct radiation is resorted to where a fan system would be more satisfactory and economical. We think this is due possibly to the feeling in general that a fan system is more or less guess-work. Nothing is further from the truth, for the science of hot blast heating has been developed until absolute results can be guaranteed by the leading concerns.

When concrete surfaces are discolored as a result of smoke, soot and similar impurities, it is sometimes possible to remove the accumulation by applying naphtha. If this fails, a light application of sandblast will entirely remove the discolored surface.

The serious loss of life attending fires in combustible buildings occupied by large numbers of persons is usually due to the loss of presence of mind and consequent panic. On the other hand, buildings constructed and equipped in accordance with approved fire-resisting methods impart confidence to their occupants, and in the event of fire the process of evacuating the building takes the form of an orderly procession instead of a wild stampede. An instance is recorded in the columns of our contemporary, Concrete-Cement Age, where it is stated that on the outbreak of fire in a tall building in New York, some 600 men and women escaped with perfect safety. The building was constructed with concrete floors, convenient fire escapes, and insulated lift shafts, the result being that the strength and durability of the floors gave confidence to the workers, who found their way down the insulated shafts with order and safety.

Specifications Covering the Rolling of Road Crusts of Various Types

By W. W. Crosby†

BEFORE proceeding to details, it seems necessary, for the sake of clearness, to state certain general principles in regard to specifications. Recognition of them may be more general than the speaker is aware, but it seems to him their emphasis at the expense of reiteration is demanded by the apparent frequency of their neglect.

In the first place, while it may be necessary sometimes to restrict in details the methods to be followed, generally it will be found more satisfactory to specify the results to be obtained rather than one exact method for reaching the result. Elasticity for meeting variations in conditions encountered will then not be wanting. This is especially true as regards rolling.

Secondly: where necessary the methods of producing the result may be limited by specific description but this should be done only when unavoidable for the insurance of proper results and for preventing the production of a result which will be offered for acceptance as "just as good."

Thirdly: for economic reasons as much elasticity as is practicable should be given in the provisions for limits, in the descriptions of the machinery or tools allowed for use.

Fourthly: the specification of the result to be secured should be absolutely definite, clear, and as brief as may be consistent. The specification should so describe the product that no more room for argument as to the fulfillment of the specification will exist than will be occupied by a few questions whose answers can and must be determined by scientific methods, such as physical or chemical analyses and arithmetical calculations or measurements.

With specifications drawn on the basis of the foregoing, most of the difficulties complained of in many specifications would be obviated. The ever-recurrent question of the interpretation of the clauses would have eliminated from it such extremely annoying and indefinite factors as the meaning of many phrases, the permitting of substitute methods, the personal equation in interpretations under varied conditions, and resolved itself into simply, What will be the maximum allowance of variation from the specified results without making the actual result secured unacceptable?

Assuming now that the specifications in regard to the road crust have been drawn in all other points on the basis outlined, the clauses regarding the rolling will be considered.

As a horrible example of what **not to do,** the follow-may be cited:—

"Immediately after the application of the refined tar, a layer of dry No. 1 broken stone, not to exceed three eighths of an inch in thickness, shall be spread and broomed, as directed by the Engineer, over the surface of the refined tar, and shall be at once rolled as directed by the Engineer with a roller weighing between eight and fifteen tons."

This is not a "creature of the imagination" of the writer, but really a verbatim extract from a set of specifications recently adopted as "standard" (save the mark!) by a national society of considerable pretensions. It is not the intention of the writer to digress into a discussion of either the syntax of the clause or the propriety of the expression "as directed by the engineer." Familiarity of his readers with such discussion will be assumed. He merely wishes to illustrate by the quotations his remarks here. Take the foregoing as the "Before" picture. Let us see how an "After" looks.

Immediately after the application of the refined tar, No. 1 broken stone shall be spread and broomed into an even layer that will not be over three-eighths of an inch in thickness over the surface of the refined tar, and this layer shall be at once rolled with a roller of not less than eight nor more than fifteen tons in weight. The rolling shall be continued until the surface shall be compact and even.

Which form of the clause is more definitely interpreted? Under which are opportunities for the display of idiosyncracies of engineer and contractor greater? Under which form is it more easily possible to estimate the cost of doing the work and then to name a definite price for it?

For further illustration of the theme, let us consider for a moment a clause from the printed specifications for macadam used by a large English city:

"The second coat (of metal) shall then be uniformly applied and the whole surface shall receive a thin coating of fine granite chippings or other binding material, approved by the City Surveyor, not exceeding one inch in size, which **shall be well rolled again three times."**

Now regardless of whether this city surveyor, who it may be supposed is at least not expected to be of extraordinarily small size in any particular, would lose his job and be supplanted (by what?) if the commas were lost, is not the inelasticity or unnecessary and inconvenient rigidity of the clause as it stands apparent?

Again, from a large city's (in this country) specifications:

"When the grading has been completed, the entire surface **shall be rolled not less than three times** with a steam roller weighing not less than 350 pounds per lineal inch of roller; or, if in the opinion of the Engineer, the use of a steam roller is impracticable, he may permit the use of a horse-roller weighing not less than 250 pounds per inch."

Will any two contractors estimate the cost of the rolling under this clause at the same figures?

One more illustration, this time from specifications of one of the so-called progressive cities of the country. (It has now a City Manager who seems to be doing good work, and perhaps it should be presumed that the city's specifications have since been brought beyond criticism. Nevertheless the counterpart of the clause may also be found elsewhere).

"The surface must be made perfectly even by heated smoothers and be rolled with a steam roller weighing not less than 250 lbs. to the inch run, the rolling must be continued for not less than five hours for each 1,000 square yards of surface."

Does this mean that the roller must be constantly moving and, if so, at what rate of speed? Will rolling part of the 1,000 square yards of surface once, and the rest of it as many more times as may be necessary to occup the period, fulfill the specification?

Various other questions are easily framed, and it is necessary to consider the possibilities for all such questions as have been suggested, because of the conditions usually present in connection with public work —the great bulk of highway work. It is futile to argue that the clauses as they stand should be readily understood to mean this or that by all competent highway engineers and contractors, and that the questions above suggested are merely captious criticisms. But contractors for public work of this character are not yet usually selected and invited to bid. The bidding is open to all—experienced or inexperienced, intelligent or stupid, straight or crooked, who can fulfil certain requirements (generally financial ones) and the difficulties in the way of rejecting the low bid are well known. Many green contractors have to be educated; many would-be sharp ones held in the narrow path; and competition in bidding must be encouraged. Again, the supply of inspectors, as well as of contractors, must be examined through the same glasses, and provisions made for using that material also to the best advantage, considering its likely qualities. Friction as well as lawsuits must be avoided.

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*Paper presented before Section D of the American Association for the Advancement of Science, at the Philadelphia Meeting, December 30-31, 1914.

†Consulting Engineer, Baltimore, Md.

As far as possible, there should be left no opportunity for such questions as are indicated above, and the specifications may, to this end, even express (to a certain extent and as before suggested) definite methods to be followed in the production of results, and contain an exact description of the results themselves.

Having criticized what has been done, it is but fair that the writer should specifically propose something to be done in this line and illustrate his proposition also. To attempt to cover here every case of rolling the road crust would be probably as unnecessary as it would be uninteresting to the reader. Hence the writer will limit his suggestions to what he considers a few, but perhaps typical, exhibits.

He thinks the "Rolling" clauses should be as follows:

FOR "WATERBOUND MACADAM"

Sub-Grade

"The portion of the road-bed prepared for the crust shall be — feet wide, be brought to the grades and cross sections shown on the plans, and be rolled with a self-propelled roller until firm and solid. All depressions that may appear during the rolling shall be filled with approved earth and re-rolled until a firm, even surface with a proper grade and cross-section shall be obtained."

First Course

"After the layer of broken stone, slag, gravel, shells, or other metal for the first course shall have been spread uniformly to the proper cross section, it shall be rolled with a three-wheeled, self-propelled roller, weighing not less than ten tons, until the layer shall be compacted to form a firm, even surface. Should any serious difficulty in connecting such metal as certain granite rocks be experienced while rolling, lightly spreading the layer with sand or other material or sprinkling it with water, all as may be approved by the Engineer, shall be employed. The rolling shall begin at the sides and work toward the centre of the roadway, thoroughly covering the space with the rear wheels of the roller. The rolling shall be discontinued before the pieces of metal lose their angular character.

"Should any unevenness or depressions appear during or after the rolling of the first course, they shall be remedied with fresh metal of the same kind as previously used and the rolling shall thereupon be resumed and continued until a firm, uniform and even surface shall be obtained. Should sub-grade material appear at any time to have churned up into or mixed with the metal of the first course, the contractor shall, at his own expense and without extra compensation, dig out and remove the mixture of sub-grade material and metal and replace the same with clean, fresh metal of the same kind as previously used in this course, thoroughly re-rolling and compacting the fresh metal so that the first course shall finally be firm, uniform and even on its surface with the latter at the proper grades and cross sections."

Second Course

"After the metal for the second course shall have been spread to the proper thickness and cross-sections, it shall be rolled as hereinbefore provided under the head of "First Course," except that water, in connection with the rolling, shall be used as follows:—When the rolling shall have been carried on to the point where the metal of the second course will not push or "weave" ahead of the roller and any depressions or unevennesses have been properly remedied as provided, the rolling shall be interrupted and a thin layer of sand, screenings, or other approved binding material, shall be evenly spread over the surface of the second course metal with as little disturbance of the latter as possible. The quantity of fine material so applied shall be just sufficient to cover the metal and care shall be exercised to avoid its use in excess. Water shall then be sprinkled on the roadway surface and the rolling at the same time resumed, the quantity of water used being such as will prevent the fine material from sticking to the wheels of the roller. The combined watering and rolling shall be continued until the voids of the metal shall become so filled with the finer particles as to result in a wave of water being pushed along the roadway surface ahead of the roller wheel. The watering and rolling shall then be discontinued until the macadam shall have dried out. If then the metal shall begin to loosen and to appear on the roadway surface, or if the voids in the metal shall appear to be not properly filled, the watering and rolling shall be resumed with the application of only as much additional fine material as may be necessary. Any depressions or movements appearing during the above operations shall be remedied by the contractor as hereinbefore provided and when completed, the macadam shall be uniform, firm, compact and of at least the thickness required and shall have an even surface nowhere departing by more than one inch from the grades and cross sections shown on the plans."

BRICK PAVEMENTS

Sub-Grade

"The portion of the road-bed prepared for the crust shall be —— feet wide, be brought to the grades and cross sections shown on the plans, and be rolled with a self-propelled roller until firm and solid. All depressions that may appear during the rolling shall be filled with approved earth and re-rolled until a firm, even surface with a proper grade and cross-section shall be obtained."

Cushion

"After the material for the cushion shall have been evenly distributed to the proper thickness and spread to the proper grades and cross sections, it shall be thoroughly, firmly and evenly compacted by rolling. The roller shall weigh not less than ten pounds per inch in length, should approximate twenty-four niches in diameter, and shall not be more than thirty inches in length. After rolling until the cushion shall be properly compacted as above prescribed, the template shall be applied, and if the surface of the cushion shall be found to be not uniformly parallel to the surface required for the finished pavement nor at the proper grades, the defects shall be remedied and the rolling shall then be repeated."

Rolling the Brick

"After the brick for the pavement shall have been laid as provided and the surface of the roadway swept clean, the brick shall be rolled with a self-propelled tandem roller, having a weight of not less than three nor of more than five tons. The first passage of the roller over the brick shall be at a slow pace, shall be begun at the curb, and the rolling shall, by means of overlapping passages parallel to the curb, proceed to the centre of the street. The rolling shall then proceed from the other curb to the centre in the same manner. The roadway shall thereafter be rolled transversely by parallel overlapping passages from curb to curb at each angle of forty-five degrees, with the curbs, and finally by passages of the roller parallel to the curbs as at first above described. When the rolling shall have been completed, as above described, the surface shall be even at the proper grades and cross-sections. Any depression exceeding one-quarter of an inch in depth under a ten foot straight edge laid on the surface of the brick parallel with the curb shall be properly remedied by the contractor, at his own expense and without extra compensation."

Personal Mention

Mr. J. B. K. Fisken, architect, has opened an office in Room 201, 23 Scott street, Toronto.

Mr. F. W. W. Doane, City Engineer of Halifax, N.S., is on military service on the outposts near Halifax.

Mr. E. S. Fraser, Town Engineer of New Glasgow, N.S., has submitted a comprehensive report on permanent paving work in the city.

Mr. J. F. Armstrong, C.E., has been appointed engineer of the water and sewerage department at St. John, N.B., under City Engineer Murdoch. Mr. Armstrong graduated from the University of New Brunswick in 1910 and took a postgraduate course in hydraulics at McGill University where he made a special study of city water supply systems. He has had considerable experience in the installation of water and sewerage systems in the province of Alberta.

Medicine Hat to Lose City Engineer Grimmer

Mr. A. K. Grimmer, City Engineer of Medicine Hat, is resigning on March 1 owing to ill health and is returning to his old home at St. Andrews, N.B., for an extended rest.

Mr. Grimmer is a native of St. Andrews and a graduate of the University of New Brunswick. After an extended experience in all branches of engineering work[*] he went to Medicine Hat as City Engineer, in March, 1910, since which time the city has increased in population from 4,000 to 15,000.

It goes without saying that during Mr. Grimmer's administration public work at Medicine Hat has developed rapidly. The original water plant was found inadequate and abandoned. A new combined electric power and water plant, having an electrical capacity of 4,500 h.p., was constructed. The water plant has a pumping capacity of nine millions gallons per 24 hours and a mechanical filtration capacity of six million gallons. It is equipped with the most modern appliances for efficient and economical operation. The cost of its construction was $500,000. In addition to this, the distribution system was extended twenty-six miles at a cost of some $250,000 and a reinforced concrete reservoir, having a capacity of 2,750,000 gallons, was built at a cost of $52,500. The whole plant is designed for a population of 30,000.

A complete system of domestic sewers was developed by Mr. Grimmer and twenty-five miles have been constructed. Two sewage pumping stations have been built at a cost of approximately $400,000. A complete system of surface sewers was laid out and eight miles have been constructed at a cost of $100,000.

Twenty-one miles of sidewalk and eleven miles of curb and gutter have been constructed at an outlay of $255,000.

The natural gas distribution system has been extended thirty-five miles and fifteen gas wells have been completed at an expenditure of $150,000.

Over and above these works, which, in themselves, are noteworthy in a city like Medicine Hat, there has been proportionate development in other branches of municipal activity, such as stream diversion; the development of a stores and purchasing department for the control of all city purchases; the macadamizing of streets; the construction of retaining walls; the lighting of streets, and so on.

During Mr. Grimmer's administration, practically all construction work has been done by day labor, with the exception of the drilling of gas wells. The deduction is that Mr. Grimmer's exceptional efficiency as a supervisor justified the Council in continuing the system.

Mainly Constructional

East and West—From Coast to Coast

WESTERN CANADA

The ratepayers of South Vancouver have passed a by-law to raise $400,000 for the construction of sewers.

Mr. T. Aird Murray has prepared plans for the proposed sewerage system and sewage disposal plant at Canora, Sask., for which the ratepayers of that town have passed a by-law to raise $500,000. The work is not likely to be put in hand for some time.

From New Westminster, B.C., comes the report that the Laminated Materials Company, of Boston, are making arrangements with the Dominion Match Company to lease their factory at Brunette River with a view to establishing a branch for the manufacture of laminated wood.

The power house which the Provincial Government of Manitoba has been building on Broadway Avenue, Winnipeg, at a cost of $150,000, is practically completed. The work was carried out under the supervision of the Provincial architect, Mr. V. W. Horwood, by the National Construction Company, Winnipeg.

EASTERN CANADA

The Mechanical Engineering Company, Limited, have moved the office and works from 129 Mill street, Montreal, to 55 Cote street.

The foundation work has been completed for an addition to the Regal Road school, Toronto, which is estimated to cost $100,000. Messrs. Chalkley & Son have the masonry contract.

Mr. Paul Seurot, consulting engineer, Montreal, has been retained by the City Council to draw up plans and specifications and make estimates for the proposed tunnel under the Lachine Canal.

The Oglivie Flour Mills Company, Limited, have given Messrs. Barnett & McQueen Company, Limited, the contract for a $200,000 addition to the elevator at Fort William. The addition will have a capacity of 750,000 bushels.

Exterior work in advancing rapidly on the Loyola College at Montreal, and the walls are now up. The general contractors are Messrs. Anglins, Limited, and the architects are Messrs. Peden & McLaren, both Montreal firms.

At Three Rivers, Que., work has started on the steel frame work of the proposed post office and customs house. The general contractors for the new building are Messrs. F. A. Verrette & Company. The estimated cost is $225,000.

In connection with the erection of the post office and customs house at St. John, N.B., it is interesting to note that sub-tenders are being received for the electric wiring and fixtures. The building is to be two storeys high, 200 x 160 ft. in dimensions, of artificial stone construction. The estimated cost is $500,000. Mr. G. E. Fairweather, of St. John, is the architect and Messrs. Rhodes Curry Company, of Amherst, are the general contractors.

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[*] Details of this experience were given in our Annual Number of April 24, 1912, under the feature, "The City Engineers of the Dominion."

At North Toronto work has started on the installation of the water main system, which is estimated to cost $600,000. Mr. R. C. Harris, Commissioner of Works for the City of Toronto, is superintending the undertaking. The work is being carried out by day labor.

Good progress is being made on the customs house which is being erected at Fort William, Ont., at a cost of $175,000. The building is to be three storeys high, 100 x 80 ft. in dimension, of steel, stone and reinforced concrete construction. The general contractor is Mr. W. Braden, of Fort William.

At Hamilton, Ont., work is in progress on the new $1,000,000 factory for the Proctor Gamble Compeny, of Ivorydale, Ohio. At the present stage, No. 1 Factory is completed, and the steel work for No. 2 is finished. The new buildings are to be three storeys high, of reinforced concrete, hollow tile and brick construction.

It has been decided to go ahead with an addition to No. 1 Elevator of the Montreal Harbour Commissioners. This makes the second addition to the elevator, rendered necessary by the large increase of the grain traffic of the port. The work will be commenced early in the spring, the addition being made to the west end of the structure. It involves the removal of the wharf office building.

Mr. Charles Sharp, contractor of Hamilton, Ont., fell down an elevator shaft recently and is reported to have been severely injured.

Mr. Horatio F. Forrest, a prominent Canadian civil engineer, died at Winnipeg on January 19th at the age of 76. He was one of the engineers who located the Canadian Pacific tracks between Winnipeg and Kenora. Subsequently he filled the position of District Engineer for the Canadian Northern Railway.

Mr. H. M. White, the City Manager of Dayton, Ohio, of whom so much has been heard lately on account of his appointment having been practically the first of its kind, is forty-five years of age. He is a qualified civil engineer with a long experience in practical and executive engineering. Before going to Dayton he was City Engineer of Cincinnatti. His present post carries with it a salary of $12,500 a year.

Outside the new parliament buildings by far the greatest work of construction under way in Winnipeg is that undertaken by the Canadian Pacific Railway in improvements to its Winnipeg terminals and to the Royal Alexandra hotel. This work, when completed, will cost $1,500,000. The addition to the Royal Alexandra hotel, which has just been finished, cost over eight hundred thousand dollars. In all, 247 rooms were added, giving the hotel a total accommodation of 650 rooms. Included in the new wing are ten private dining rooms, one new grill room, and magnificent assembly and ball rooms. The hotel also has what is reputed to be the largest kitchen in Canada, measuring 50 x 239 feet.

The Privy Council has decided against the City of Toronto in the appeal of the Toronto Suburban Railway Company against an order of the Ontario Railway Board directing the company to relay and pave its tracks on Davenport road, Bathurst street, etc. The Privy Council rules that the Railway Board and the Ontario Courts placed a wrong interpretation on the word "tracks"; that under the terms of the company's agreement with the city it is only required to repair and not to reconstruct. It is stated that the financial loss to the city as a result of the adverse decision will be approximately $50,000.

Contractors' Half-Million-Dollar Claim

AT Vancouver, in the Supreme Court, an action has been brought by James McIlwee & Sons against Messrs. Foley Bros., Welch & Stewart, for the recovery of damages amounting to no less than $527,000, which they claim to have sustained through the cancellation of an agreement in connection with the boring of the Rogers Pass Tunnel in the Selkirks for the C. P. R. Experts called in on the case are Mr. James Macdonell, the well-known railroad contractor, and Mr. Alex. R. McKenzie, consulting civil engineer. The plaintiffs, who are the largest tunnel contractors on the continent, were sub-contractors under defendants by virtue of a contract in which they agreed to bore the pioneer tunnel, 7 x 8 feet, to the side of the main tunnel, as at varied intervals transverse tunnels were run to the main bore.

They were also to bore the main tunnel core, 8 x 11 feet, the defendants to enlarge the bore to the size required for the completed tunnel.

The pioneer tunnel and centre core were of solid rock, and the scale agreed to for the pioneer tunnel was $20 per foot, the centre core to be paid for at $22.50 per foot, with a bonus allowed of $1,000 per foot for every foot bored in excess of 900 feet per month.

No bonus was to be paid on the centre heading, but plaintiffs claim big profits were made on this, while in the pioneer bore they created a record by boring 1,115 feet in one month, a total which has never before been accomplished even when boring from two faces. Plaintiffs claim that the profits on the centre bore and also the distance, are settled quantities, as the defendants were paying the plaintiffs' men and providing the powder and other materials free, by agreement.

Plaintiffs allege that after the contract had been in force for some five months, defendants, seeing the progress made by plaintiffs by their improved methods, cancelled the contract.

The reason put forward by defendants for this step was to the effect that plaintiffs had run the ventilating fans for a few minutes longer per day than was absolutely necessary and had thereby robbed other contractors of their share of the air and hindered their work.

Plaintiffs' reply to this allegation is that the loss to the defendants was approximately $1 per day, a minor detail in a two-million-dollar contract, and further that the ventilating fans were not run long enough, also that the ventilating pipe supplied by defendants was admittedly of an inferior quality, and that they would not keep it tight.

Messrs. McIlwee claim their profits were $30,000 per month, and that there was no valid reason for the concellation of the agreement, the excuse given by defendants being a subterfuge, and they are therefore suing for profits due under the contract and the bonus.

Defendants' reply to the action is that it was impossible for plaintiffs to claim bonuses for rapid work, as the nature of the rock to be encountered as the bore progressed through the mountain was such that the work would of necessity become slower, and a bonus could not be figured out until the work was completed, their argument being that at the completion of the boring the plaintiffs would in all probability have no bonus due to them.

Geological experts and experts in tunnel work from all over the world have been taken to Vancouver to testify.

Mr. D. J. Clark, a St. John (N.B.) contractor, has been presented with a complete modern set of office furniture by his employees. The address was read by Mr. R. H. Cushing, C.E., chief of staff.

Montreal Builders' Exchange Annual Meeting

THE annual meeting of the Montreal Builders' Exchange was held on January 25 at their offices, Victoria Square, Mr. T. Gilday, president, being in the chair.

In the course of his report, the President stated: "In submitting to you the seventeenth annual presidential report of the Montreal Builders' Exchange I am pleased to say that notwithstanding the business depression and financial stringency consequent upon the war, and the ups and downs of one of the most eventful years in the history of this Exchange, we have come through in a very creditable manner.

"We began the year with a very considerable deficit and this was increased during the first four months of the year owing to the fact that we had so much unrentable space in the Exhibit Hall, which also was the cause of the original deficit. In May we moved to our present premises which have been fitted up very conveniently and at comparatively small expense.

"The decision to do away with the Exhibit Hall and to dispose of the Bulletin has resulted in a greate decrease both in revenue and expenditure. The total receipts in 1913 amounted to $13,598.15, being over a thousand dollars more than the income of any previous year in the history of the Exchange. The receipts in 1914 were $8,058.22, and disbursements $7,996.16, leaving a balance in the bank account of $62.06.

"The statement of assets and liabilities shows a nominal surplus of $90.98. Allowing for doubtful accounts we may consider ourselves about square with the world, with prospects of a still better position in 1915. The thanks of the membership at large are due those devoted members who have contributed, in addition to their regular fees, the sum of $1,600 to keep the Exchange going while awaiting payment of arrears.

"In June last, several important amendments to the bylaws of the Exchange were passed defining different classifications of members, increasing the annual fee for ordinary members from $20 to $30 and authorizing a small emergency assessment, all of which, the committee having the matter in hand believe, will ensure the Exchange being maintained on a self-supporting basis. It is evident that if it costs $6,000 a year to run the Exchange and there is no revenue outside of fees, it will take 200 members at $20 each to contribute the necessary funds. With 300 members the fee could be reduced to $20 each while with additional members or outside revenue the Exchange could undertake extra work for the benefit of its members.

"The Exchange was disappointed when it was found that the Federal Government had decided not to bring in improved legislation on Insolvency which we, and several other important public bodies, had asked for. The agitation for this should be continued and vigorously prosecuted.

"On the other hand, the Government passed a statute increasing the duty on imported dressed stone which was petitioned for by this and other Exchanges, and which law has proved very beneficial to Canadian cut stone contractors.

"The Workmen's Compensation Act will require your attention at no distant date, and it would appear that the system recently inaugurated in Ontario deserved favorable consideration.

"Some of our members have been making a study of the subject of Quantity Surveying and the Exchange was asked, in the fall, by a committee of the Province of Quebec Architects' Association to hold a conference with them in regard to the establishment of such a system in Montreal. The question is one involving possibilities of great benefit to builders if a feasible arrangement can be devised."

The secretary's report stated that the year had been comparatively quiet as regards labour matters. Threats of strikes were made, but the bad times, industrially, had made it impossible for labor to successfully maintain the high wages demanded. At the same time the Exchange had suffered considerably owing to a few contractors making agreements with the Unions which were strongly opposed by the majority of the members of the Exchange interested in the same lines of business. At the present time the Exchange was officially maintaining the Open Shop principle in all departments of the building trade, while its members were at the same time paying a little better than the actual market value of labor.

The membership, and consequently the revenue, of the Exchange has been somewhat affected and doubtless will be in the future if the conflict is prolonged. There was, however, a great field of usefulness for the Exchange during these troublous times; with wise direction and loyal co-operation this organization could be of incalculable benefit to its members and the building trade in general. The Builders' Exchange was never a more vital necessity for contractors than it is to-day.

Mr. John Quinlan, of the firm of John Quinlan Company, was elected president, the other officers being: 1st vice-president, E. W. Sayer; 2nd vice-president, Ald. J. B. Barbeau; directors, John Allan, general contractor; R. F. Dykes, stone contractor; J. H. Hand, building contractor; W. M. Irving, brick and masonry; J. J. Roberts, carpentry and millwork; W. Bonnell, brick contractor; J. E. Walsh, contractor; R. S. Muir, mantel and tile; W. E. Potter, master painters and decorators; R. J. McCauley, master plumbers; Alex. Bremner, Jr., builders' supplies. Of last year's directors five were re-elected, the slate of the nomination committee being elected unanimously.

Mr. Gilday, the retiring president, installed his successor and congratulated him on his election. He also congratulated the Exchange in having such a man as Mr. Quinlan to put into the presidency. Mr. Quinlan's long experience as a director and his intimate and practical knowledge of the various branches of the building trade eminently fitted him for the responsible position which his fellow members had called him to fill.

Mr. Quinlan, in acknowledging his willingness to accept office took occasion to say a few words about the value of the Exchange to contractors. He believed the Exchange was worth 500 per cent. more to every contractor than the annual membership fee. The uniform contract form alone was worth more to a builder than could be estimated. The benefits of association with fellow craftsmen, not to speak of legislation in which builders were interested, would far more than repay the contractors who took advantage of membership in this organization. The Exchange was a big institution whether viewed from its actual benefits or its possibilities and he hoped more builders would join its rank during the current year.

Mr. D. K. Trotter, the new secretary-treasurer, was introduced to several members, who met him for the first time.

The Ceresit Waterproofing Company, of Chicago, have established their New York office at 101 Park Avenue, in the Architects' Building. Space has also been taken with the Architects' Samples Company where the products made by the Ceresit Waterproofing Company are exhibited in a way tending to demonstrate their merits and with a view to giving the architect and his client the information required in deciding upon the proper materials to use. Mr. R. E. Clarke, the New York manager, is a graduate of Columbia University. He is a capable and experienced waterproofing engineer.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Brampton, Ont.
The City Council propose to construct water mains on fifteen streets this summer. The Engineer is Mr. Wm. Treadgold.

Brantford, Ont.
The City Engineer is preparing a report on oiling of streets. This will involve the purchase of 25,000 gallons of oil, probably 40 per cent. asphaltum.

The City Council are considering the purchase of a wagon for oiling the streets. The City Engineer is Mr. T. Harry Jones.

Broadview, Sask.
The C. P. R. has signed an agreement with the Town of Broadview to construct reinforced concrete subway at Ninth Avenue and Front Street. Work will be started early in April. The head office of the company is at Montreal.

Dorval, Que.
The town council will invite tenders in March next for the construction of bituminous macadam pavement on Main Road. Estimated cost $30,000. The Assistant Secretary is Mr. Sullivan.

Hamilton, Ont.
Work will be started next spring on the construction of a $50,000 subway on Kenilworth Avenue for the Board of Control and the Grand Trunk Railway. Mr. A. F. Macallum is the Engineer. Mr. S. H. Kent is the City Clerk.

Huntsville, Ont.
The carrying out of necessary improvements to reservoir this year at an estimated cost of about $2,000 is contemplated by the town council.

Mimico, Ont.
A by-law for the construction of sidewalks on Station Road and Abbott Avenue, at a cost of $2,500, has been passed by the Village Council. Mr. Andrew Dods is the Town Clerk.

Niagara Falls, Ont.
Tenders will be received by the Clerk to the City Council, Mr. B. Carr, until 4 p.m. February 11th, for trenching and back filling for service water mains, etc., for year 1915. Plans and specifications at office of Engineer, Mr. F. J. Anderson.

The City Council has in contemplation the laying of additional water mains in the north and east sections of the city. Mr. F. J. Anderson, City Hall, is the Engineer. Mr. W. J. Seymour is the City Clerk.

Oak Bay, B. C.
The Municipal Council has decided to submit a by-law to authorize the expenditure of $26,000 in drainage work to consist of laying concrete pipes to drain streets. Mr. F. W. Clayton is the Clerk.

The necessary funds have been raised for the expenditure of $30,000 on sewerage construction here. Work will be started as soon as possible.

Ottawa, Ont.
The City Water Works Department is calling for tenders for the supply of the following materials for 1915:—Cast iron pipe, special pipe, castings, valves, hydrants, lead pipe, pig lead, and brass goods. Tenders will be received from February 10th to 23rd. Specifications, etc., may be seen after February 10th at the office of the MacLean Daily Reports, 25 Charlotte Street, Toronto. The Water-Works Engineer is Mr. R. L. Haycock.

Royal Oak, B.C.
The Municipality of Saanich is calling for tenders for the supply of material, including cast iron pipes, special castings, valves, hydrants, etc., for the Water-Works System, estimated to cost $375,000. Tenders will be received by the Town Clerk, Mr. Hector S. Cowper, Municipal Hall, Royal Oak, B.C., until noon, March 12th. Specifications at the office of the Municipal Engineer. Work will be done by day labor.

South Vancouver, B.C.
The voters of the municipality have approved a by-law to authorize the construction of sewers at a cost of $400,000. Mr. S. Barlow Bennett is City Engineer.

Stratford, Ont.
The Provincial Board of Health has recommended that a by-law be submitted to the ratepayers to authorize the expenditure of $72,000 on the construction of a main sewer in the city. The date for the voting has not yet been fixed. Mr. A. B. Manson is the Engineer. Mr. R. R. Lang, City Clerk.

Toronto, Ont.
The Board of Control call for tenders, which will close March 2nd, for 24-in., 30-in., 36-in. stop valves, and one 36-in. check valve. Specifications, etc., at Room 9, City Hall, Water Main Extension Section.

Trois Pistoles, Que.
The Parish of Trois Pistoles contemplates the construction of Municipal water-works and drainage system, and are authorized to raise money by Legislature of Quebec for the construction.

Watford, Ont.
The ratepayers here have defeated a by-law for the construction of drainage work at an estimated cost of $5,000.

Railroads, Bridges and Wharves

Hamilton, Ont.
A special committee of the City Council will request the Hamilton Street Railway Company to build two cross town lines and also relay new tracks on several streets.

Kingston, Ont.
Repairs are contemplated to the breakwater. It is estimated to spend about $1,000 on same The City Engineer is Mr. R. J. McClelland.

Malton, Ont.
The Toronto Gore Township Council propose constructing a large concrete bridge this summer. The plans have not yet been prepared. Mr. N. Harrison, R. R. No. 3, Malton, Ont., is the Clerk.

McLennan, Alta.
Plans are drawn for the construction of a round house to accommodate four engines for Edmonton, Dunvegan and B. C. Railway Company, St. Albert's Trail, Edmonton.

Onondaga, Ont.
The Township Council has in contemplation the construction of steel bridge, 50 ft. span, with concrete abutments and flooring. The question will be discussed at the next meeting to be held on March 1st. Mr. Alfred Burrill, R. R. No. 2, Cainsville, is the Township Clerk.

Ottawa, Ont.
The Ottawa and St. Lawrence Electric Railway, Union Bank Building, are starting work next spring on the Perth to Smiths Falls section of electric railroad which is making a belt 300 miles in length in Eastern Ontario. Mr. E. Malone is chief engineer.

Toronto, Ont.
The Temiskaming and Northern Ontario Railway Commission has decided to establish a number of plants for rossing settler pulpwood in Northern Ontario. Mr. J. L. Englehart, 25 Toronto Street, is Chairman.

The Toronto & York Radial Railway Company, King and Church Streets, will apply at next session of the Ontario Legislature for power to construct double track line on Yonge Street, from C. P. R. to North City Limits.

CONTRACTS AWARDED

Ottawa, Ont.
Contract has been awarded to the Dominion Bridge Company, Limited, Carleton Chambers, to supply a number of Travelling Cranes for the National Trans-continental Railway Locomotive and Car shops at Quebec. The Secretary is Mr. P. E. Ryan, Ottawa.

Province of New Brunswick
A contract has been awarded to Mr. Luther B. Smith, St. John W., for the rebuilding of the Great Salmon River Bridge in the Parish of St. Martins, St. John County, N.B. The structure will be of concrete construction.

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Specifying Local Material

COMPLAINT has been heard in some quarters that architects and engineers specify the purchase of common articles of use from a particular firm. There is a savour of arrangement and commission about this procedure which will not appeal to the professions at large. Of course, there is no objection to the specifying of a particular firm or factory when the article to be used is a special production of that firm or factory. The objection is when the materials are common products of a number of firms and factories. Our criticisms might be extended, but the sample hinted at will serve the purpose.

The contractor, in tendering, is a competitor, and the aim of a Council or buyer is to benefit by such competition. When, then, it is stipulated that the parchases shall be from a particular person, the whole object of free competition is removed and no benefit from it can accrue. Every architect and engineer of repute knows this and leaves the contractor a free hand. Our remarks are directed to a few less experienced men who, in their eagerness to make friends, go to the length of giving names of those from whom purchases must be made. This method may be perfectly right, but it may be otherwise—even though men are found who accept the conditions without protest.

The aim of a few architects and engineers is to make the contractor merely a glorified foreman to act under cast-iron rules. Work carried out under their specification cannot be termed contracting, for they would go so far as to leave the contractor no initiation in the selection of the men he employed, wages he paid, or materials used, or where the materials were to be obtained.

Standardization in Road Making

IT is asserted truly that the cost of a road is not limited to its construction and maintenance, but that it extends to its destructive or preserving action upon traffic. Bearing directly upon this question of all-round service and efficiency is the matter of experimental work and standardization.

Hitherto, experimental work in road construction has not been carried out in Canada to any great extent, although it is generally admitted that it is necessary, in order to determine the particular conditions obtaining in a particular locality. Our attainments in all classes of road work leave scope for much future effort and initiative. This need for initiative is emphasized in rather a hard cut by the Contractors' Record (London, Eng.) which consists in part of the following:—"It seems to be the bias of a cult in Canade to preach standardization, hence we find long articles and papers preaching the text of the cult. In our opinion the text is the text of a race of incapable inbeciles, a race incapable of seeing that almost every road exists under different conditions. Differing conditions require different methods and materials of construction, but these unthinking men would tar every mile with the same brush. In nineteen cases out of twenty the phrase in a specification, 'according to standard,' means the clause or sentence to be that of a man absolutely ignorant of his business—a man who merely follows and who is incapable of appraising the true value of the factors in a particular case. The bellwether has gone before, cried 'Baa, baa,' and he meekly follows behind crying 'Baa, baa.' Our difficulty in discussing standardization is that under certain circumstances a standard may be imposed, but the circumstances must be alike with those for which our standard was first designed. Imitation may be the sincerest form of flattery, but the imitation by one road engineer of the methods and materials of another when the conditions are unlike is a proof of ignorance and not of flattery."

With the general principle of opposition raised by our contemporary we are in agreement, but we are inclined to regard the actual criticism as an exaggerated one, to say the least. Road construction is in its infancy in Canada, so far as age is concerned, but the pioneer work which has been carried out in the last decade, particularly in Ontario and Quebec, could hardly have been achieved by "incapable imbeciles." In the cities and their suburbs, the tendency to standardization may have kept us backward, but the work done in the new districts, such as Northern Ontario, has reflected initiative and energy in special methods of handling equipment and machinery and the adaptation of local supplies.

Traffic and more especially climatic conditions in Canada are radically different from those in the Old Country and for some years it may be well to follow along the lines of established practice, although not adhering to any slavish standardization. We have yet to be provided with specific evidence of where Canadian road engineers have copied the methods and materials of others in face of varying traffic and climatic conditions—and in road work these are fundamental.

New Bridge at Saskatoon

THE work in connection with the Twenty-Fifth Street bridge, Saskatoon, which was begun on September 2nd, 1913, is now well advanced, the last arch having been completed. The extreme congestion of traffic on the existing bridge, especially since the construction of the municipal street railway, for a long time convinced the city authorities that another bridge over the river was an absolute necessity. Realizing this, the importance of a new bridge was urged upon the Government. The Government acted promptly in the matter, and the Provincial Highway Commissioners investigated the question, with the result that a meeting took place with the municipal authorities in January, 1912. The construction of a bridge of sufficient width, fully adequate for future requirements, was the outcome of the conference, and after consideration of several sites the present one was chosen. It was not, however, without its engineering difficulties, but these have since been surmounted.

The Twenty-Fifth Street Bridge, Saskatoon.

The plans prepared by instruction of the Provincial Highway Commissioners called for a bridge consisting of a series of arches with a floor on a practically 3 per cent. grade, in order to meet the rise of 50 feet from the west to the east side of the river. The bridge is the longest in the city, the total length being about 1,490 feet, the river at high water mark being 1,100 feet wide at this point. It consists of a series of eight arches—one arch of 25 ft. span, one of 66 ft. span, one of 92 ft. span, one of 136 ft. span, four of 150 ft. span, and one irregular arch of 95 ft. span. The 150 ft. arches are notable as being longer in span than any other in the Dominion of Canada constructed of concrete.

Particular care has been exercised in making allowance for expansion and contraction consequent upon variation in temperature. The bridge was designed for a temperature variation ranging from 50 degrees F. below zero to 90 degrees F. above, and possibly this range of temperature is larger than that contemplated for any other concrete bridge ever built on the North American continent.

The total width of the structure is 65 ft. Two eight-foot sidewalks are to be cantilevered from the roadway, provision is made for two street car tracks, and there are two 14 ft. roadways. The fencing on either side of the bridge when completed will be a concrete fence of a spindle and pedestal type design.

In the construction of the bridge a pneumatic concrete mixer and conveying machine have been employed in pouring the concrete, thus dispensing with all unnecessary trackage and cars, the concrete being conveyed into the arches through pipes. The foundations of the structure are carried down to a depth of 16 ft. below water level. Up to the present time about 725 tons of reinforcing steel rods have been used in the construction of the bridge, and for the centering of the arches 600,000 ft. of lumber have been employed. For the support of this false work 700 piles have been driven into the river bed. The workmen are now engaged in taking down the false work, and the work of pulling up the piles will begin as soon as the ice is thick enough.

The cement used in the construction has been supplied by the Canada Cement Company and the Edmonton Cement Company, and the largest proportion of the steel has been procured from Sydney, C.B. During last winter as many as 300 men were employed on the work at once, but during the summer this number was reduced to about 120, who were kept on until the work was so far completed.

The principal contractors for the work are R. J. Lecky & Company, of Regina and Saskatoon, Mr. Fred Saynor being resident engineer. The work is under the supervision of the City Engineer, Mr. Geo. S. Archibald. Work yet remaining to be carried out, and which will in all probability be commenced in the early spring, consist of the upper superstructure, including the spandrel walls and balustrades, the fence, and the foundation for the roadway, which will be all of reinforced concrete.

The total cost of the bridge will be about $400,000, the Provincial Government paying two-thirds and the city the remaining one-third.

The Human Element in Contracting*

A Factor Sometimes of Paramount Importance in Its Relation to Owner, Engineer and Architect

By L. C. Wason†

AFTER learning that there is a prospective job, a member of the company investigates its character and location, to determine whether it is within the company's specialized work, and whether it is desirable. He then meets the owner, if possible, to interest him and to size up his temperament and business methods.

The Owner

As sometimes the owner takes an active interest in the execution of the work, although he deals through his engineer or architect, it is of considerable importance to know his temperament and point of view. Greater harmony will thus be obtained. The engineer will do well to bring both parties together early and often. There is the owner who has not been seen at the time of final payment, and the one who is in evidence every day—the one who has a technical training and knows, and the one who does not know about construction, but thinks he does, and personally mixes into the work commonly considered as the engineer's. If the engineer is weak-kneed, with the last named type of owner, expense and misunderstanding are almost certain to result, primarily because no man can serve two masters, and secondarily because an ignorant master, the owner, is never satisfied. If there is a very strong, fair-minded engineer who commands the respect of his client, there is little trouble with any type of owner.

The worst combination is a fussy owner, and an engineer who has obtained his commission by hard chasing, instead of through the owner's going to him. He is the hardest to control, and makes trouble for the contractor that affects the cost of the work. The contractor, therefore, seeks to learn the probable conditions before submitting a bid.

Then it is necessary to study the engineer or architect, and consider his method of handling and supervising work. The methods of some engineers are radically different from those of others; this has a marked bearing upon the cost of the work and sometimes on its desirability to the contractor. The contractor must determine what sort of treatment he will receive. Nothing adds to the price of a bid like uncertainty, whether it be in the temperament of engineer and owner or in unknown construction problems.

In one case where a number of local firms were invited to bid on a certain large building for an architect who was well known always to rule in favor of his client, irrespective of the merits of the case, the successful bidder, after figuring full measure on all quantities, added this item—"Humor architect;" the item was 10 per cent. of the contract. It is safe to presume that all other competitors placed this contingency at a higher figure. Such a man could not get a reasonable bid from anyone who knew him, and he certainly could not expect to let work advantageously to guileless strangers. An engineer in a distant city, whose reputation has reached beyond the limits of his activities, has a personal equation of 25 per cent. plus. The best information available indicates that these men do not personally profit in any way improperly in this excess cost. Instead of being wise and just judges between the two contracting parties, they are simply over-zealous partisans. Fortunately this class of architect and engineer is very small, and their influence on industry still smaller.

The largest class is that in which the engineer or architect intends always to be just, but on rare occasions allows his judgment to be influenced by the attitude of the owner; or, where two different solutions may be possible, for policy's sake or for hope of personal advancement, makes the second best decision. This increased expense which is entailed can never be foreseen, although it certainly exists, and has to be paid for as a contingent item of cost. The reputation of the engineer who is always fair spreads far and wide, and he is sought out by many responsible contractors who desire to do his work. This results in work being done at the lowest legitimate cost by competest firms; the owner gets a square deal, continues himself, and also recommends his friends, to employ this engineer, who in the long run prospers more than he could by other methods. Meanwhile, he maintains his self-respect and is justly proud of work well done.

Contractors talk rather freely among themselves about their experiences and their opinion of those for whom they have worked, and, perhaps oftener than is imagined, are asked by owners whom they would recommend to design new work. They certainly exert an influence on the reputation and also on the business of the engineer.

Very frequently persons who are following dangerous vocations are careful that their apparel shall in no wise increase the risk they are taking. Yet many men engaged in handling high-tension wires wear a black stiff hat, not having observed that there is an electrical conductor embedded in the rim of the hat. A fatal accident resulting from this type of hat has rather forcibly called attention to the fact that each hat of this kind is made with a steel wire as the reinforcing element of the rim. A sub-station foreman on an electric line in Northern Indiana was explaining details of some work to his men in a recently completed sub-station. In pointing out a joint in the high-tension wiring, hat in hand, the rim of the hat came into contact with the wiring. The circuit was completed from the high-tension line through the small steel wire and the man's body to the ground, thereby causing a shock which proved fatal. In view of the above accident, it might be well for men in the electrical industry to specify hats with non-conducting reinforcement in their future purchases.

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* Extract from a paper read before the Boston Society of Civil Engineers.

† President Aberthaw Construction Company, Boston, Mass

The Value and Application of Unit Labor Constants

Specially Contributed by R. O. Wynne-Roberts, M. Inst. C E., M. Can. Soc. C.E., F.R. San. Inst., Consulting Engineer. Regina

ONE of the most interesting and instructive studies in connection with public works is that of working out the estimated unit costs of the work proposed to be carried out, and afterwards comparing them with the actual unit costs when the work is completed. Such a study warrants the expense, for it is by such method that the engineer and contractor can prepare reliable estimates.

If one item alone is considered—cement concrete for example—it will be acknowledged that the method of estimating the cost per cubic yard, or cubic foot, or any other unit of measurement, is often a rough guess, more or less approximate. If, however, each item which goes to make the concrete is carefully considered and its cost analyzed, the result will be more reliable.

Mr. R. O. Wynne-Roberts.

The same remark often applies to other work, such as excavation in different soils and rock, brickwork of different qualities, steel work, reinforced concrete, forms, and so on.

Some engineers and contractors keep a carefully-prepared analysis of the costs of different works and when called upon to estimate for similar work they have the necesary data to guide them.

The cost of materials is regulated by the ordinary law of supply and demand. The cost of lumber, for instance, varies from time to time; it also differs from place to place, more or less in proportion to the distance from the sources of supply. The cost of the materials is affected in a similar manner. Consequently it will be seen how difficult it is to compare the cost of work done in the east with that in the west, or even one work executed in Winnipeg with another in Calgary, although the jobs may be similar. Unless the actual cost of the materials on the ground is known in both cases, it is of little service for the engineer or contractor to know that concrete of a specified quality cost $9.00 in one place and $6.00 in another.

The cost of material is also influenced by the waste that occurs. Cement is a commodity which can be easily wasted, whereas fabricated steel is not so, to the same extent, although both are products of factories.

General and incidental expenses of an engineer's office or of the contractor's staff and plant are items of importance, yet how often do we find it stated that the concrete, brickwork, steel work, etc., have cost so much per unit in place; but no mention is made as to whether the costs include superintenrence, use of plant, rent, etc. The erection and use of plant, waste in lumber, and items of like nature should be included, of course, or the omission should be stated, otherwise the costs are very misleading.

The contractor's profit is next added. This represents his remuneration for services rendered, for risks undertaken, interest on capital invested and for use of capital between certificate periods, and to cover contingencies which owing to the nature of the work cannot be always foreseen.

The information which is published in the technical press would be most useful if the items were stated clearly, and if what is included in the prices were set out more definitely. This failure is not peculiar to the technical press, for we find the same indefiniteness in books, which are professedly written for contractors' use. The cost of concrete in Chicago or Pittsburg is practically useless information to persons living in Canada, although, were the prices of cement, sand, stone and labor mentioned, it would be possible to apply the information.

In preparing an estimate the engineer or contractor can easily compute the net quantity of lumber necessarv for a building, the number of bricks required, the quantity of excavation, and so on. Lumber will cost so much per 1,000 B.M. and brick so much per 1,000 delivered on the site. The total cost of these and other items is fixed by the size of the job. The labor required to execute the work is not a fixed quantity; it varies with the materials handled, the quality of the work, the season, and other contingencies. The author is fully aware that the cost of labor for different jobs is estimated by competent engineers and contractors with considerable exactitude, which doubtless suffices for the purpose. It is interesting and useful, nevertheless, to gather data on the subject. Such data to be of any use, should be prepared on a recognized principle.

Several authors have given an elaborate list of items of work and have stated the cost of labor per cubic yard, cubic foot, square, square yard, etc., without giving any idea as to the local price of labor, and consequently such information is difficult or even impossible to use. For instance, one author writes "Brick in lime mortar in rectangular chimney shaft up to say 30 ft. in height per superficial yard 1½ brick thick"—(price given). Another item is "trench excavation, including timbering to sides, keeping excavation clear of water, depositing and roughly levelling soil from the surface to six feet below, per cubic yard"—(price given). The price of labor is not stated. The excavation may be in clay or sand. The depositing of soil may be 10 or 50 yards away. The cost of removing tht surplus spoil may or may not be included. Such is the ambiguity of many items.

Each engineer and contractor can easily keep particulars of unit labor costs. Hurst, many years ago, pointed out the need for an improved method of analyzing the cost of labor on various jobs, and recommended computing what he called "Constants of Labor" which represent "the amount of work a workman will perform in a given time."

A laborer can excavate as much earth of a given class in one part of a country as another; he can mix as much concrete as another man. A bricklayer can lay as much brick of any kind as another, provided conditions are alike. If we know how many hours an average laborer requires to excavate one cubic yard of earth or to mix one cubic yard of concrete, then we have some data of a definite character. Suppose a laborer can dig one cubic yard of earth in 45 minutes, then the labor constant is 0.75 hour per cubic yard, and if the wages paid are $2.25 per day of 10 hours, which equals 22½ cents an hour, then one cubic yard will cost for labor 0.75 x 22.5 = 16.875 cents. Suppose six men can mix by hand 10 cubic yards of concrete in eight hours, then the labor constant is $\frac{6 \times 8}{10} = 4.8$ hours per cubic yard; and if the wages per hour are 22.5 cents, then one cubic yard costs 4.8 x 22.5 = $1.08 for labor. Say a bricklayer and a laborer can lay 1,000 bricks in nine hours, then the labor constant will be nine hours per 1,000 brick. If the bricklayer receives 45 cents and the laborer 22½ cents an hour, then the labor cost per 1,000 bricks laid will be

9 x 45 = 4.05
9 x 22½ = 2.025

6.075 per M.

The reader can extend these examples ad lib. The labor constants are appliable to all parts, whereas the wages paid may vary greatly. The unit may be anything, either cubic yard, cubic foot, square yard, per 1,000, per square, or any other standard of measurement is stated.

By means of unit labor constants arrived at after careful observations over more or less extensive periods it will be possible to compare the amount of work under similar conditions on different jobs and at different places. As already explained, the published labor costs of work done in Minneapolis or Chicago, Vancouver, Toronto, or Liverpool, are of very little relative value, although the work done may be very similar, because the wages paid are different in each case; yet if the unit labor constants were published, we could utilize the information to much advantage.

Having described a method which is applicable to all classes of work, it may be interesting to give a few examples of unit labor constants extracted from various publications and reports.

	Hours per cubic yd.
Excavation in ordinary earth 1 ft. deep	0.50
Excavation in ordinary earth 4 ft. deep	1.00
Excavation in ordinary earth and wheel, 200 ft.	1.50
Mixing concrete by hand	2.70
Machine mixing of concrete	1.80
Machine mixing and placing concrete in excavation, 27 to 10 ft. below surface	5.74
Machine mixing and placing concrete in excavation, 10 to 6 ft. below surface	4.85
Off loading gravel and cement	1.06
Building forms in tunnel	1.09
Erecting forms in tunnel	1.74
Stripping forms in tunnel	0.30
Rubble masonry on slope, 12 ins. thick	10.00
Rubble masonry wall, mason and labor, each	2.60

	Hours per 1000 brick
Bricklaying in thick wall	9.00
Bricklaying in average wall	10.00
Bricklaying, pressed brick face	25.00
Bricklaying, veneering	20.00

	Hours per 100 sq. yds.
Fixing wood laths	8.00
2 coats plaster, plasterers' time	6.00
2 coats plaster, helpers' time	4.00
Finish, plasterers' time	9.50
Finish, helpers' time	6.50
Painting large surface	5.40
Painting small surface	9.00
Painting head rail plain walls	10.00
Painting floors	6.00
Graining	32.00
Varnishing, plain	16.00
Varnishing, floor	10.00
Varnishing, old oak	22.00

	Hours per 100 square feet B. M.
Carpenters, frame building	2.00
Carpenters, 3 x 12 in joints	1.10
Carpenters, Howe truss, 60 ft. span	11.60
Carpenters, joints and sheeting, 1, 2 and 3 floors	1.70
Carpenters, joists and sheetings, 4 and 5 floors	2.25

	Hours per square
Shingles, 4½-in. weather	1.80
Siding	4.00
Floors, 4 ins. wide	4.50
Floors, 2 ins. thick	4.50
Square edge maple	3.80
Maple 2½ in. face and smoothed	4.50
Wainscotting	5.00
Tar and gravel roof	1.25

	Hours
Drilling 1¼-in. holes in concrete	1.00 per ft
Team work	0.75 per load mile
Hnd rivetting	16.00 per 100 rivets
Pneumatic rivetting	6.00 per 100 rivets
Laying ¾-in. galvanized iron pipe	10.00 per 100 ft.
Unloading cement	3.00 per 100 bags

It is desirable to state that the foregoing unit labor constants are not submitted as authentic results of the writer's experience, but at tentative constants to illustrate the value of data prepared on this principle.

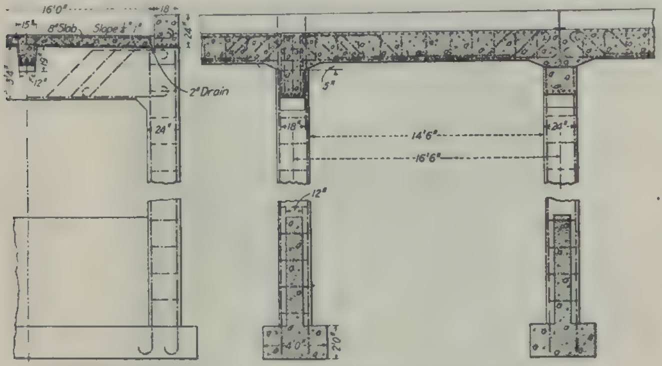
A Reinforced Concrete Highway Trestle*

A reinforced-concrete trestle with 16½-ft. spans combining economy and simplicity of outline with strength and light dimensions has been designed by the writer under the direction of T. F. Nichols, office engineer in the Engineering Department of the State of Arizona. The dimensions of the trestle are shown in the accompanying drawing. The pier web, or wall between supporting columns of bents, is to be carried 2 ft. above high water when the stream is subject to high floods and carries much drift, or as high as the prevailing conditions may suggest.

Assumed Loadings

For the design the following live and dead loads were assumed: Live loads, 20-ton road roller with two-fifths of its weight on the front axle and three-fifths on the rear, axles 11 ft. on centres, front wheel 4 ft. wide, rear wheels 2 ft. wide and 5 ft. on centres; no impact allowance; dead load, applicable weight of structure assuming a unit weight of 150 lb. per cubic foot for reinforced concrete and 100 lbs. per cubic foot for surfacing.

The positions of the roller giving maximum bending moments on the structure were determined. The dead weight was assumed as being uniformly distributed with one exception. For the central beam the maximum bending moment was found to occur when the rear wheels of the roller were placed at its centre equidistant from it on either side, with the load assumed to be distributed over 4½ ft. longitudinally; for the curb beams, when one rear wheel was alongside of it at its centre and its weight acted as a concentrated load; for the cross beams, when the maximum roller load was concentrated at its centre. The position of the roller giving the maximum shear was also determined for all cases.



Half Transverse Section

Longitudinal Section on Center Line

Details of fixed ends and expansion joints of standard trestle spans.

Assumptions of Design

Because of the lightness of superstructure and piers, it was necessary that in general not less than three spans be considered as a unit, the centre span being fixed, thereby securing the required longitudinal rigidity. This centre span is fixed by rods from the posts and stirrups from the cross beam; the other spans have one end free. Because of the indeterminate degree of fixity, the lightness of the structure and unknown construction factors, all members affected were designed both as fixed beams and as beams freely supported, thereby securing the maximum possible bending moments for all possible conditions.

Slabs.—The slabs were designed as beams fixed at the curb and at the centre beams. They were reinforced for equal positive moment and negative moment throughout because of possible action as continuous beams.

Curb Beams.—The minimum dimensions of the curb beams were fixed as shown. They were reinforced throughout for maximum negative moments, regarded as fixed beams, and for maximum positive moments regarded as freely supported. The slabs were not considered effective.

Centre Beams.—The centre beam was reinforced on the same principle as the crub beams, but the design was based on T-beam action with a 36-in. flange. For the required end depth it was considered as a rectangular beam measured from the top of the slab.

Provisions were made in both centre and curb beams for a negative moment throughout, due to possible continuity of spans.

Cross Beams.—The cross beams were designed as fixed beams. The bottom of the centre beam is above the neutral axis on the compression side, and the beam is deeper than required in order to give bearing for the slab.

The columns are much in excess of requirements, as are the footings, for all except the most difficult foundation conditions.

Unit stresses were $f_c = 650$ and $f_s = 16{,}000$ lb. per square inch, with $p = 0.0078$.

Notes on Construction

Posts, web and cross beam are to be poured as a unit. Slab, curb beams and centre beam are to be poured as a unit continuously between expansion joints. Expansion joints are to be placed at least as often as every third span; they are to be ⅛ in. wide, filled with asphalt, pitch or other suitable plastic material. Bearing at expansion joints is to be on tar paper. All corners are to be finished with a ¾-in. triangular bevel.

It will be understood that this design is applicable only to comparatively low crossings, not being economical for high structures. Bearing in mind the design assumptions, it is evident that merely by making slight modifications in the arrangement and quantity of steel this design can be made applicable to one-span or two-span units without requiring any computation, provided that longitudinal rigidity of the structure be maintained.

While this bridge is designed to withstand all possible contingencies of action, some of which are unlikely, and is considerably over-strong for its requirements, the dimensions are still as small as practice would recommend. The quantity of steel required by these combined assumptions is very little in excess of that required by any one of the assumptions, since it takes the place of special shear reinforcement which would otherwise have to be provided.

A Bill to register architects in New York was introduced in the Senate on January 14 and referred to the Committee on Judiciary. The bill provides that every person, before being known as an architect, must secure a state certificate of his qualification to practice under that title. A board of examiners is provided for, to be appointed by the Regents of the University of New York. Candidates in order to take the examination before the board must have had an education equivalent to an approved high school course, and, in addition, such courses in mathematics, history and one modern language as are given in the first two years of a college course. The candidate must in addition have had five years' practical experience in an architect's office. Persons engaged in the practice of architecture when the law takes effect are given a certificate without an examination. A fee of $25 is fixed for the issue of a certificate, and practice without a certificate is made a misdemeanor punishable by fine or imprisonment.

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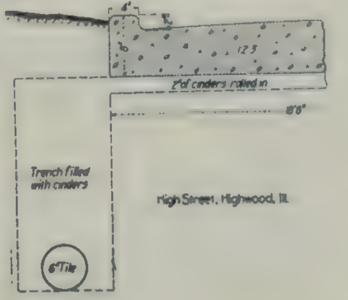
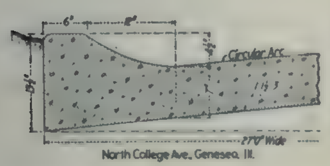
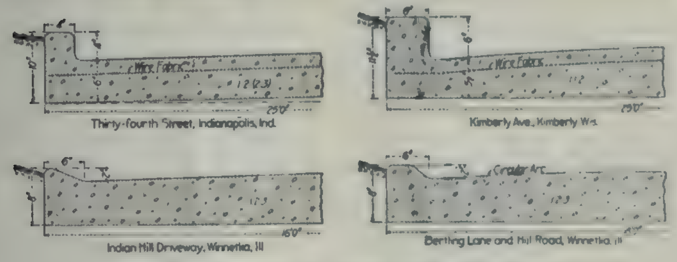
* By S. M. Cotten, in The Engineering Record.

Costs Reduced by Monolithic Curb, Gutter and Pavement

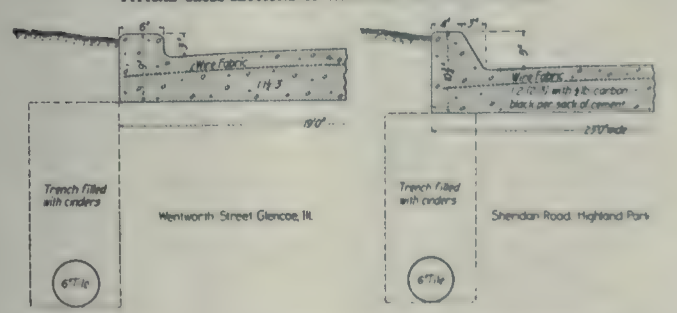
By casting concrete curbs, gutters and pavements as monoliths the cost of highway and suburban road construction in the Middle West has been considerably reduced. Typical cross-sections of the various designs are shown herewith. The reason usually given for including the curb with the pavement is the greater economy over the usual type of curb and gutter, the cost of which runs from $3,500 to $5,000 per mile. The bid cost on curbs often bears little or no relation to the actual cost, but is largely a matter of custom. Integral curbs add but a small amount in yardage of concrete, and the cost, depending on the type, should not be more than one-fifth to one-tenth of the above figures. Distributed over the total area of the pavement there is added but a few cents per square yard to the pavement cost.






6"
Wire Fabric
1:2 (2:3)
10"
25'0"
Thirty-fourth Street, Indianapolis, Ind.
6"
Wire Fabric
1:1:2
25'0"
Kimberly Ave., Kimberly Wis.
6"
1:2:3
16'0"
Indian Hill Driveway, Winnetka, Ill
6"
Circular Arc
1:2:3
Berthing Lane and Hill Road, Winnetka, Ill

TYPICAL CROSS-SECTIONS OF INTEGRAL CURB AND PAVEMENT


6"
Wire Fabric
1:1½:3
19'0"
Trench filled with cinders
6" Tile
Wentworth Street Glencoe, Ill.
4"
5"
Wire Fabric
1:2 (2:3) with 1 lb carbon black per sack of cement
25'0" wide
Trench filled with cinders
6" Tile
Sheridan Road, Highland Park

Drainage provisions and details, showing variation in practice in three Illinois cities.

Of the various types those used in Glencoe and in Highland Park seem to be the ones more generally favored for suburban pavements. Where a former macadam road existed and the parking was sloped down to meet the pavement at the lowest point, the Winnetka type has worked out well. With reinforcing in the slab it is usual to place the concrete in two layers, adding the curb with the second coat. Carpenter braces are used to hold a form board against spacers. On flat grades the curb height varies between inlets from 2 to 8 inches.

Where the pavement is laid in one course some form of curve gutter is used, as exemplified in the Geneseo and Winnetka sections. The strike board is then cut away to give the proper shape. In the Highwood job the cinders were rolled into a rather soft subgrade to stabilize the foundation. Engineering Record.

The Operation of Small Sewage Treatment Plants

The following suggestions for the proper operation of small sewage disposal plants, where expert supervision cannot be afforded, are from the report of the Committee on Sewerage of the Indiana Engineering Society:

Plain Septic and Imhoff Tanks.—As the purpose of such tanks is mainly for the separation and rentention of the suspended matter to as great a degree as possible, the tanks should be kept in such condition that this will be accomplished, otherwise efficiency will be impaired. To get the best results large accumulations of septic sludge should be avoided when they cause violent ebulition and a consequent carrying over of the sludge to the filters. The sludge should be removed when necessary.

In using Imhoff tanks the sludge should not be allowed to get above the depositing slots at the bottom of the settling chamber.

Large and unusual flows through the tank, such as storm water flows, should be diverted, especially in plain septic or sedimentation tanks. The removal of suspended matter should be as complete as possible, as the less of this matter reaches the filter beds the less trouble there will be in operation. Sludge should be blown off when possible at regular intervals, or at time of high water, unless provision is made for sludge drying.

In the event that there is no stream large enough to carry off the sludge at high water then a sludge bed, well underdrained, should be constructed and the sludge run on to this bed, allowed to drain and then renewed afterward. Settling chambers of Imhoff tanks should be kept free of sludge, and in some cases where the slope of the hopper bottom is not steep enough the sludge should be pushed down through the slots or otherwise removed.

In some Imhoff tanks sludge mats are likely to form on the top surface of settling chambers and it will usually be found better to clean this mat off at intervals.

The effluent from tanks of any kind should be examined at regular intervals. If solids are carried over it is likely to cause trouble in the syphons, and in the case of contact beds the sludge, if carried over in quantities, will clog the bed in time.

Contact Filters.—The main trouble with contact beds is the tendency toward clogging. Contact beds should not be overworked and should have stated periods of rest. It is impossible not to get some matter carried over from the tank, but this can be taken care of in a way to cause the least trouble, and to catch most of the material before it works into the beds. Proper and complete underdrainage will assist greatly in getting rid of accumulations, but it is safe to say that few contact beds are very thoroughly underdrained. Too little regard is usually given to good underdrainage and proper bottom construction to contact filters.

In operating contact filters they should be filled by dosing; the sewage should then stand for several hours, usually about two hours. At the end of the contact period they should be automatically discharged and should have a suitable resting period of at least six to eight hours. Should the beds become clogged the stone must be removed and cleaned or new stone placed.

Sand Filters.—The sand filter is not so liable to trouble as the contact bed, but it goes without saying it should be kept as free as possible from material that will clog. When ponding occurs the bed should be raked about ¾ in. deep. The bed can be allowed to dry and the top skin will peel easily and can then be raked off. Slopes around filters should be sodded so that clay or dirt will not get into the sand and clog it.

Where the sewage is discharged by distributors into the bed it will be found advantageous to place large gravel or broken stone at such points, so that the sand will not be washed out or scoured.

Low spots on the sand area should be kept filled so that the sewage will flow level and all parts worked as uniformly as possible. In freezing weather the surface of the filter should be furrowed.

In conclusion operators who are not getting proper results out of their plants, or if they notice unusual conditions, should notify the State Board of Health, with a view toward getting things in proper shape.

The Selection of Deep Well Pumping Machinery

A discussion of the comparative merits of various types of pumping machinery for deep wells was given at the recent annual meeting of the Illinois Society of Engineers and Surveyors, by Douglas A. Graham, Chicago, and is reported by Engineering News.

The three principal types of machinery available for deep-well pumping are, first, the air lift, second, reciprocating or plunger pumps, and, third, rotary pumps, including both turbine and propeller type. The rotary turbine pump is usually the most expensive in first cost and the air lift the cheapest, the reciprocating and propeller pumps coming in between the two. In efficiency, the plunger pump ranks first, the rotary pump second, while the air lift is generally a poor third. From the point of view of reliability, however, the air lift, which has all its moving parts above ground and easily accessible for inspection and repairs is well in the lead, with the reciprocating pump second, and the rotary pump third.

Other conditions, however, must be considered in connection with the installation of pumps. For example, a turbine rotary pump could not be successfully used in a well smaller than 12 in. diameter. A crooked well, making necessary a bend in the rods of a plunger pump or the shafting of a rotary pump, is bound to cause breakdowns and repairs if such pumps are installed, while the air lift is admirably adapted to such places. The air lift is also well suited to water high in sulphuric acid or carrying large amounts of sand, both of which cause serious injury to rotary or reciprocating pumps.

Variations of water level in the well have an important relation to the service given by the pump; and it must be remembered that the water level drops rapidly as the rate of pumping increases. The air-lift pump requires submergence of the air pipe of about 60 per cent. to give best results. Air-lift installations should be thoroughly tested while the erecting force is on the ground by continuous heavy pumping to determine the minimum water level, so that the submergence of the pipe in the well can be increased if necessary. Many tests of old air-lift plants show efficiencies as low as 10 per cent., partly due to changing water levels and partly to improvements in design. Manufacturers' guarantees on air-lift pumps at the present day are as high as 30 to 40 per cent

A plunger pump must have its barrel as low as the lowest water level to be expected or there will be liability of the pump sucking air with danger of breakage. The turbine pump has the same limitations as the plunger pump, and in addition its efficiency and capacity are at a maximum for a very limited range of head fluctuation. Some forms of rotary pumps are free from this objection.

The efficiency and reliability of any pumping plant may be greatly affected by the manner in which it is erected. Preferably a pump should be installed by its makers or their representatives who can be held responsible for the machinery and the manner in which it is placed. The air-lift pump is least likely to serious injury by careless or incompetent operations, although its efficiency under such conditions may fall off materially.

Inasmuch as the selection of the machinery to be used depends upon the character of the well, it is important to determine this in advance of the purchase of machinery. Unfortunately, this is not always easy. If the well is a new one, then departures from straightness in its bore can be determined and a test of the water level can be made if sufficient funds are available to pay for the necessary pumping tests. Pumping installations are most frequently made in the smaller towns and villages, where the engineer, if there is one, is generally closely limited in the expenditure permissible. Nevertheless, apparatus which will show the water level in a well should be a part of every well-pumping plant. Such apparatus costs but a few dollars, and the knowledge of a falling water level gained in advance may save the wrecking of costly machinery.

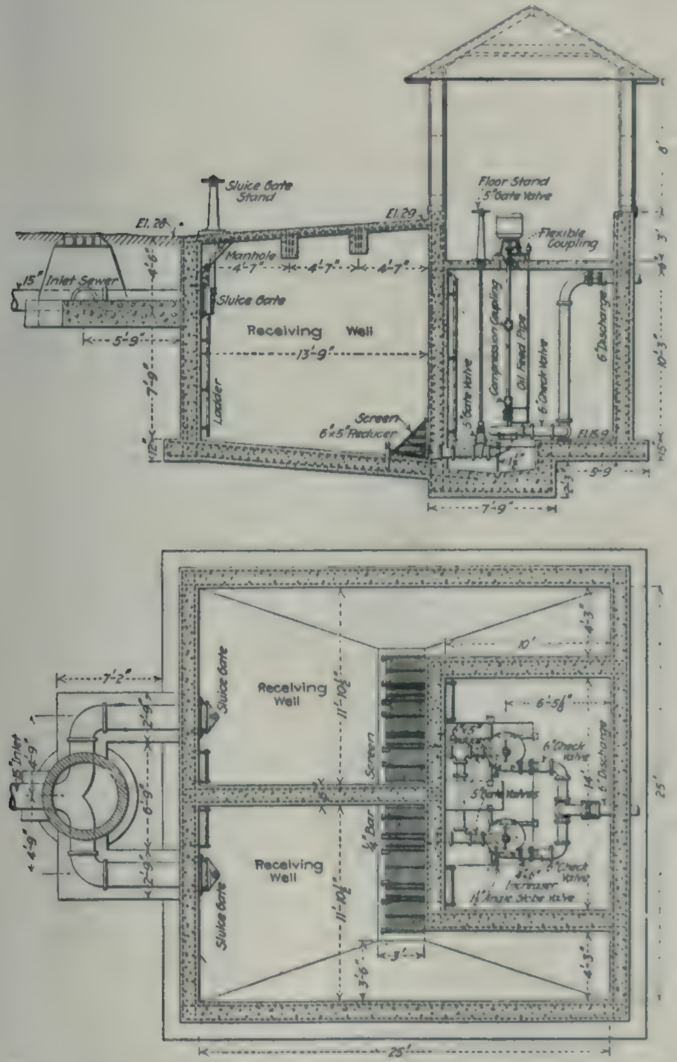
In order that concrete may be poured simultaneously on both sides of expansion joints in pavements, thus obviating all delay occasioned by placing the joint, a template form has been devised. This form consists of a 2-in. plank, framed on the bottom edge to the crown of the roadway and flanked along each side by pairs of ⅜ x 2-in. plates, 6 ins. long. The material for the expansion joint, Elastite, is inserted between these plates, which hold it in shape. The device is fastened across the roadway at the expansion joint by means of the plank, and concrete poured on both sides of it. While the concrete it still green, the plank and the plates attached to it are pulled out, leaving the finished joint. This way of placing expansion joints is in use by the Illinois State Highways Commission on work near Harvey.

In our report of the 29th Annual Meeting of the Canadian Society of Civil Engineers, published in our last issue, we referred briefly to the address delivered at the Banquet by the Hon. Sir George Foster, Minister of Trade and Commerce, stating that points therefrom would be published in this issue. Instead we are reserving the address for editorial comment in our next issue (February 17) which will be a special British Empire Number.

An Electric Sewage-Pumping Station

IN laying out the sewers at Audubon, N.J., it was found necessary to lift the sewage from one drainage area to a high-level gravity sewer. The accompanying drawings, which, with the details, are given by courtesy of Engineering News, show the general arrangement of the sumps, screens, motors and pumps found advisable.

There are two centrifugal pumps with 5-in. suction and 4-in. delivery openings. The pumps are especially designed for handling sewage and to pass solids up to 1 cu. in. They have single-suction castings, on lower side, flared for easy entrance and carrying water directly to the impeller. Each pump has a capacity of 200 gal. per min., against a head of 50 ft., including friction, when operating at a speed of 1200 r.p.m. The volute is cast iron, one piece with openings in the sides slightly larger than the impeller to permit easy removal of the latter. The impellers are of cast bronze of the open type with canes and web to hub. The shaft is of Tobin bronze extended through the pump bearing, fitted with a rigid coupling, and a stuffing-box at the top of the pump bearing. The shafts are directly connected through flexible couplings to vertical 10-h.p. motors. The specifications called for an efficiency of 52 per cent. for the combined unit.



Plan and sectional elevation of electric sewage pumping station at Audubon. N. J.

The intake well is divided into two parts and the pumps may draw from either or both sections at the same time. The two pumps discharge into a 6-in. cast-iron force main which enters the gravity sewer at a distance of 800 ft.

Protecting Newly-Paved Streets

THE City of Baltimore, Md., is spending many millions of dollars repaving its streets, and in order to give these pavements a fair chance of long and useful life, the city paving commission is making a direct appeal to property owners. The following notice is served on all property owners before paving operations are begun. It is proposed to serve the latter half of the notice again, when the pavement is completed:

Before Paving Operations are Begun

You are hereby notified that the street fronting this property is to be paved with improved pavement, and that the work will commence after six weeks subsequent to the date of this notice.

All necessary underground construction for installing or repairing gas, water, electric and other subway structures must be done before the street is paved. After the new pavement is laid, no permits to uct trenches or to disturb the pavement will be issued. Notice to the above effect has been given by public advertisement.

During Paving Operations

In order to assist this department in obtaining good work, and assisting the contractor in every way, the following suggestions are offered.

Do not allow unnecessary waste water to flow upon the streets, which interferes with and delays the work, and causes unnecessary expense.

Do not persist in passing "STREET CLOSED" signs, as they are put up to protect the work and should be obeyed.

Do not use a hose on a newly laid street, as the force of the water tends to tear out the filler between the blocks before it has become hardened.

If you have a complaint to make, do not argue with the foreman on the work; call up the Paving Commission's office.

After Paving Operations are Completed

In order to assist in the proper care of improved pavements, in which every property owner and leaseholder should be interested, the following suggestions are made:

Do not allow your servants to throw soapy or polluted water on the streets. Have this emptied into a sink, so that it will be carried into a sewer.

Do not throw paper, trash, etc., in gutters, as it is not only unsightly, but it dams the water flow in the gutters, causing it to spread out over a large area of the street.

Do not allow oils, gasoline, etc., to drop upon improved pavements, especially asphalt.

Do not chop ice off of improved pavements with sharp-edged tools, which penetrate the ice and injure the pavement below.

If you are a builder, pile your building materials on a platform; not directly on the street.

There is a law relating to the above suggestions. Be a law-abiding citizen.

The railways interested in the new $65,000,000 Union Station Project at Chicago have formally accepted the city ordinance for the undertaking and have turned over to the municipal officials the sum of $825,805 as compensation for the closing of certain streets and alleys needed for the new terminals. This completes the legal formalities as far as the city is concerned. The commencement of construction, it is announced, depends upon the development in the financial situation. As soon as the necessary financing can be done at reasonable cost the work will be started.

Hints to Contractors on Hiring and Keeping Good Men

IT is always a comparatively easy matter to criticize and find fault with people, conditions, and methods, and quite difficult to do better or advise how improvements can be made. This is very true of handling men on construction work. It is not possible to give exact rules and regulations that can be followed in every case, for men themselves, both those to be managed and those doing the managing, are strikingly different, and the conditions under which men must be worked vary greatly; but some general principles can be laid down and advice given that can be applied by discerning contractors and managers.

First, is the employment of men. Laborers cannot be employed with the same care and scrutiny that should be used with foremen, clerks, bookkeepers and mechanics, but some discretion should be exercised. It is a poor way, generally bringing bad results, to allow foremen to hire the men. Few foremen seem to have much judgment in selecting men, and it is not within the province of foremen who have to work the men to hire them. This sometimes leads to serious abuses. The writer knows of one contractor who allows a stable foreman to hire all of his teamsters. This boss soon found that he could make money by charging the men a fee for giving them a job. Thus the engaging of men became so profitable that many of them were discharged so that the foreman could hire new ones, making more money. Then men began to pay him to hold their jobs until the system of monthly payments was developed. It is evident that this contractor does not really control his work, although he may think he does. This teaming is controlled by his foreman, who is grafting on his men, but the cost of all this is coming from the contractor. Many similar cases could be mentioned from the writer's own knowledge. The easiest way to prevent such grafting is to cut off such power from foremen.

If the contractor is carrying on small operations, he should employ his own men; but few contractors can do this, so it is well to have one man on each job to do the hiring of men for the construction work. In most cases this man will be the general manager or superintendent, but on some large jobs he, too, may be too busy to give time to this important detail. Then another man must be selected. The man who is allowed to do it must not be taken up with his own importance, which is a common failing of too many men who are given some authority that can be exercised before the public. This kind of man is as apt to employ the worst men applying, as he is the best, for he will be attempting to impress the men, instead of forming a fair estimate of their ability.

It is a difficult matter to judge a man for both physical and mental work. For a common laborer at the usual wages paid it is not expected to obtain a man of great mental ability, nor is it always a requisite; yet the greater the intelligence up to a certain point, the quicker the man is likely to learn and the better his work will be. However, a man of great mental ability, even if he has the necessary physical strength, is not as likely to do monotonous physical work as well as a man of less intelligence. The thinking man will soon become dissatisfied, for instead of having his mind on his work, he is apt to be thinking of other things and planning for himself. A strong man of fair intelligence makes the best manual worker. These remarks do not apply to mechanics.

To get physical endurance does not mean to select large men. They are frequently strong and able to put forth great exertion for a short time, but the man for endurance is the average sized man of stocky build. He is apt to be quicker in his movements than the large, heavy man, will size up easier with other workmen and can keep up a regular pace much longer. The stout man is often very strong and answers for many different kinds of work, but he is not suited for all kinds of laboring. The under-sized man is to be preferred to the large man as a general thing.

The short man has many advantages in stooping over and working close to the ground over the large man. The man with broad shoulders and well developed arms and with a tapering body is well suited for such work as picking, using an axe, or striking hammer or maul. The stout heavy man is suited for work with a bar, dumping carts and scrapers, tilting mixers and other work where weight and great strength are needed for a short time. The man with a muscular back, broad hips and stout legs is suited for heavy work that needs endurance. These and other physical characteristics should be studied in selecting and hiring men.

Under many circumstances nearly all men applying for work will be hired; then the selecting of men for different kinds of work will depend upon their physical appearance, and this should be a guide even after the men become known from weeks and months of work. It is only too common to see men placed at work for which they are not suited physically.

It is not as easy to select men for intelligence as it is for physical ability, yet every employer should attempt to get laborers of fair mental ability, although, the man of low intelligence can also be made to do efficient work if intelligently handled and guided.

The man with eyes set far apart, with heavy jaws and a stout short neck, inclined to give his head a drooped appearance, is generally of low mental calibre. The man with eyes far apart, long thin neck and short pointed features possesses more intelligence than the other and is generally easily led and managed. He is seldom sure of himself but can be encouraged to do any physical work under a competent foreman. The man with deep set eyes, with angular features, is one that is sure of himself and his ability. He takes himself and his work seriously, is difficult to manage for he feels he does not need a boss, but if handled right can be worked as desired and led to improve on his fellow workmen's methods.

The man with the close set piercing eyes and strong facial features possesses more than the average intelligence. He should make the best and most intelligent workman, but his mental ability often makes him the shirker, the "slick" one, who gains the goodwill of his incompetent fellow workmen by helping them to beat the boss. He is the man who, in spite of his intelligence, must be driven and kept so busy that he cannot get himself into mischief.

The great mass of the common laborers possess little in their faces to show their mental ability, so that such men can only be known by working them.

All these and many other things are considerations in hiring men, especially when selections can be made from a number of applicants.

When men apply for work there are a number of things they should be told promptly. First, the wages paid and the hours of work. Also when pay days occur, and for what period of time they receive their money on each pay day. For city work this about covers the conditions; but for work on jobs in the country, where men must board or live in camps, then more should be told them, such as the price of board, or how they can get their supplies, the charge for bedding and for fuel, if one is made. The cost for doctor's attendance and hospital service should all be explained. Machine runners and mechanics should be told the rules and regulations governing their work, the care that is to be taken of the machines, and the periods of cleaning and overhauling them.

Regulations in Pamphlet Form

The easiest method of doing this is to have these various regulations printed in a small pamphlet and, when employing men, to allow them to read it. Men who cannot read will find some one who will read to them. The applicant, if he is not satisfied, can refuse employment, but if he accepts a job, he agrees to abide by the regulations. This prevents a lot of trouble and to some extent makes a contract between the employer and his employees If a man's work is limited, the regulations can be written on a typewriter and a number of carbon copies made. A half dozen copies will last a long time, as they are kept in the office, the men returning them after reading.

In employing others than common laborers, as foremen, mechanics, machine runners and clerks, it is necessary to ask questions in order to learn what experience these men have had in the different lines of work. This only serves as a part guide, for many of these men become very expert in telling of what they can do and have done, appropriating to themselves the experience of others upon the jobs on which they may have been employed. Many of them show letters of reference, stating they were employed by different contractors. These letters are of little value. Naturally letters of reference are not given to men who have been discharged in a fit of anger by their employers, of for breaking up machinery by ignorance and carelessness. Nevertheless many men are put off because of poor ability or are gladly let out at the end of a job, who could not find employment again from the same contractor except in a pinch, yet letters are given them stating that they were employed and possibly recommending them to others. This is done to get rid of the men without offending them. This fact makes the value of all letters of reference or recommendation held by such men questionable.

A contractor carrying on small operations cannot afford to hold men even on half pay from one job to another, or from season to season, but a contractor running a large number of jobs and amounting to a large sum in the aggregate will find temporary employment for his best men during the off seasons or between jobs, or will carry his men on full or half pay. To others, whom he cannot afford to take care of in this manner, he will promise re-employment as soon as he can use them. Thus his good men are cared for during slack periods and few of them are looking for jobs. Even if he lets them go without promises, he is glad to hire the capable men again as soon as he can use them. Indeed, a contratcor carrying on large operations considers the men of ability in his organization or those formerly in his employ, whose addresses he endeavors to keep, as one of his assets. One trouble a man starting into contracting has is to obtain and hold competent men. He is not able to pay large salaries and the best men in the business have jobs and can only be induced to leave their present employers by offers of larger salaries and regular work.

Thus the contractor looking for such men, can question applicants and pick out those he thinks may be competent, but the only way to be certain of their ability is to try them. A discharged man may have learned a lesson from his discharge and thus become a valuable employee.

The foregoing remarks have been based upon the assumption that men are plentiful and a contractor is receiving many applicants from men, so that he can exercise some choice; but at times workmen of all classes are scarce and the contractor is compelled to employ anyone that he can get. Then he must work them, good or indifferent, until he can obtain a better class of help.

In many cases men are so scarce that the contractor must rely almost entirely upon labor agents to obtain most of his help. The mechanic and various kinds of union men can sometimes be obtained through the labor unions, but even these in some places may have to be obtained through labor agents. It must be remembered that labor agents pay a license to do their business and sometimes, where they send men from one state to another, they must pay a large fee as an immigrant agent, so that these agents must make money through supplying men. They have office rent to pay, and must hire sub-agents to furnish men from congested labor markets of centres, likewise runners to collect men and deliver them on jobs. They must sometimes furnish men with lodging and food. They also have to advertise to obtain men, and likewise to place men with employers. Thus labor agents are under heavy expenses, and they must do a large business to make a living. Like the dealers in horses they must place the poor ones as well as the good ones, for all is grist that comes to their mill.

More About the Labor Agent

A contractor makes a mistake in simply ordering a lot of men from a labor agent. He will obtain in this way an indifferent lot, many of whom will be worthless from the start. Others, who may be competent, may feel disappointed in the conditions surrounding the work, or feel that they have been deceived by the agent. They accordingly leave the work and carry many others with them. No matter what results the contractor obtains from the new workmen, the labor agent has done his part and earned his fee.

With a padrone furnishing men, conditions are slightly different. The padrone has to look after the housing of the men, their board and supplies. He, too, must suffer if the men are dissatisfied, but even with the padrone worthless men may be procured.

No matter how the men are obtained, either direct from a labor agent or through a padrone, it is well, if any number of men are to be hired, to send a responsible man to see the new men before they start for the work, unless the job is in the same city as the labor agent's office. The rules and regulations as to pay, hours of work, boarding and many other matters of vital interest to the men, previously mentioned, can be told to the laborers before they leave the charge of the labor agent. Photographs of the camp and work can be shown and many other things done to win the confidence of the applicants. Then the men can hardly be deceived and the party of men after reaching the work are likely to stick, with the possible exception of one or two. A shrewd man in looking over those applying for work will exclude some that are likely to prove worthless and will likewise reject any "sea lawyers," who are more than apt to make trouble.

The labor agent may object to some of these things being done, but if he is handled in a courteous manner, and given to understand that the contractor will give him more business if he can obtain satisfactory men, his objections will be withdrawn. The chance of the contractor's own agent grafting on the men with some labor agents, who care little for their own reputation, is considerable. For this and other reasons already mentioned the contractor should only send a responsible man on such a journey, one whom he can trust.

These things show the necessity of having at least one man, and sometimes more, on the job, who can do the hiring of the men, laborers especially. So vital is this matter to the contractor that he should do his part of his work himself; but if this is not possible, and he must rely on others, then he should keep in touch with the men who do his hiring and give the matter as close supervision as possible. Such men should not be drinkers, for they are likely to bring more injury onto the contractor than would the labor agents. The contractor should make it convenient to be present from time to time with his hiring agents and also go on trips with them to engage men. In all these matters it is the contractor's money which is at stake.—The Contractor.

Methods of Patching and Repairing Concrete

SPECIAL inquiry made by the Committee on Masonry of the American Railway Engineering Association, has brought forth information as to the various methods practised in the important work of patching and repairing concrete. They are summarized as follows:

Wet Method.—The surface of the old concrete is thoroughly roughened, cleaned, and drenched with water, and covered with a cement grout. Then the new concrete is mixed to a sloppy consistency and applied, being held in place till set by forms, as required.

From the reports received, it appears that many successes and many failures have followed this method. Where it has been successful, that result probably has been due to painstaking care and expense being employed in the preliminary cleaning and thorough wetting of the old concrete surfaces before the new concrete is applied.

Moderately Dry Method.—The surface of the old concrete is thoroughly roughened, cleaned, and drenched with water, and powdered with cement or painted with cement grout, after which the new concrete is applied and thoroughly tamped against the old surface. Generally, such patches are kept moist by sprinkling them with water for several days.

The same comment applies here as to the wet method.

Dowel Method.—This is a modification of the two preceding methods, and is generally used for other than horizontal surfaces, although it may be applied to the latter. The new concrete may have any consistency to meet the particular conditions or the ideas of the engineer in charge; but usually a fairly wet concrete is used. This method includes drilling holes and setting dowels into the old concrete, with projecting ends to engage into the new concrete. Sometimes steel bars or metal fabric are connected to these dowels to further ensure permanency of the pitch.

This method can be made uniformly successful, but cannot always be applied. Where any considerable mass of new concrete is to be connected to old concrete, this is the only safe method to pursue.

Wedge Method.—This method includes the cutting-out of defective concrete in such a manner as to under-cut the surrounding good concrete so that the new concrete will be held in place, when set, by the shape of the binding edges of the old concrete.

The difficulty of under-cutting concrete so as to secure such edges is too great to make this method applicable in ordinary cases; and, except where a considerable depth of new concrete is to be put in, such under-cutting could not be successfully done, as concrete cannot be cut so as to leave sharp, clean edges.

Cleaning with Steam.—This is a method of cleaning surfaces of old concrete, preparatory to putting on a patch of new, or of cleaning the top of a rough concrete floor before applying the "finish coat." The surface of the old concrete is brushed as clean as possible with stiff brushes, and then gone over at least twice with a steam jet. An ordinary piece of ½-in. gas pipe makes a very satisfactory jet nozzle. This short length of pipe is connected to a steam hose so that it can be readily moved about. The steam is supplied by the boilers of the mixer or hoisting engines. The steam will clean and heat the concrete surface, leaving it perfectly dry; so it is important to drench the surface thoroughly with water after cleaning with steam. In cold weather, it is found advantageous to use hot water. Immediately after the surface is thoroughly cleaned and drenched, the new concrete is applied.

Excellent results have followed the use of this method of cleaning; but it is essential that the surface of the old concrete be thoroughly drenched with water after using the steam jet, otherwise the new concrete will not adhere to the old.

Cleaning with Acid.—This method includes washing of the surface of the old concrete with a solution of hydrochloric (muriatic) acid (one part acid to two parts water), after which the surface must be carefully and thoroughly washed to remove any free acid.

This is a very commonly applied method of cleaning old concrete surfaces preparatory to placing new concrete against them, and, by many, is considered the only safe treatment to use, especially in cases where a "finish coat" is to be put on after the concrete base is set.

Conclusions.—The following conclusions as to the methods of repairing defective or worn surfaces of concrete are presented:

1. In all cases, the surface to be repaired must first be thoroughly cleaned of all loose material, laitance, and dust; and the clean, rough, sound concrete exposed to receive the patch. Probably the best method of cleaning is by means of a steam jet.

2. After cleaning, the surface to be repaired must be thoroughly saturated with water, not simply moistened, but so thoroughly drenched that the old concrete will not absorb water from the new mortar or concrete used in patching. If possible, the surface should be kept covered with water for several hours.

3. If the repair or patch is to be made on a vertical or sloping surface, and is not to be more than 1½ in. thick, the surface of the old concrete, while it is still wet, should be spattered or splashed with a cement grout, following this immediately with a fairly stiff plaster coat of mortar made of the same proportions of cement and sand as used in the original concrete, but not dragged with a trowel. The surface of each coat, except the final coat, should be "scratched" to give a bond for the next coat. This plastering should preferably begin at the top and progress downward, and only enough time be allowed to permit each coat to receive its initial set before the next coat is applied. The final coat should be finished with a wooden float, and only enough water used to finish the surface properly. This patch should be kept damp and protected from sun or frost till fully set up.

4. If the repair or patch or "finish coat" is to be made on a horizontal or nearly horizontal surface, the surface of the old concrete should be slushed and broomed with a thin cement grout, following this immediately with a wet mortar made of 1 part cement and 2½ parts sand or granite screenings, and of the full thickness required (not less than ½ in. thick, however). When this mortar begins to take its initial set, it should be floated or troweled to such a finish as may be desired.

5. If the repair or patch is to be made on a vertical or sloping face and is to be more than 1½ in. thick, it will be advisable to embed dowels in the old concrete as deeply as the thickness of the proposed patch, and space them sufficiently close together to anchor the patch firmly to the old concrete. The dowels must be wedged into the old concrete; and it will be advisable to fasten wires, metal fabric, or bars to the dowels, in the case of extensive patching, as an additional safeguard. The patching may then be done with mortar without forms, or with wet concrete supported by forms, depending upon the thickness and the extent of the patch.

6. If the repair or patch is to be made on a horizontal or nearly horizontal face and of considerable thickness, dowels may be used, or the concrete may simply be reinforced by fabric or bars without using dowels—treating the patch as a block of masonry.

7. Care must be taken not to have thin edges on patches. To avoid this, it may be necessary to cut out sound concrete around a place to be patched, so as to give deep edges to the patch. If possible, the edges should be under-cut.

The problem of the removal of snow from city streets proves a vexed and expensive one. Particular interest is now being centered in the recent innovation in Toronto of utilzing storm sewers for the disposal of the snow. A special manhole built at the corner of Gould and Mutual streets for the experiment, will enable snow to be dumped direct from carts into the manhole. A water jet has been fixed in the manhole to prevent the congestion of the sewer. Owing to sewage disposal complications it has been deemed inadvisable to use domestic sewers for this purpose. If the proposal proves a success we have here an additional argument in favor of the separate system of sewers.

Effect of Varying Amount of Water in Concrete

In a paper read by R. K. Skelton before the Connecticut Society of Engineers, results are given of a series of careful tests made to determine the effect of varying the percentage of water in concrete. The tests were made in the Masonry Materials Laboratory of the Sheffield Scientific School, by Mr. Robinson, under the direction of Professor Barney and with the assistance of Messrs. Lewis and Sherman. Following, in summary, are the conclusions drawn:

> The percentage of water has a direct bearing upon the strength of concrete. Nevertheless, it is the exception rather than the rule, that the engineer concerns himself with the question of mixing beyond seeing that the proper proportions of sand, stone, and cement are used. Careful tests are made of the cement and steel, both standard articles put out by firms which have reputations to maintain; on rare occasions, the water is analyzed; but no attempt is made to control the mixing. On some pieces of work, the contractor is furnished the cement so that there will be no temptation to skimp on materials. He is then given the liberty to mix these materials as he sees fit. He may aim to get the maximum strength out of them, but it is probable that he will strive rather to keep the cost of mixing and placing at a minimum.
>
> Of course, it must be admitted that the strongest mixture is not always the most desirable or economical. In preparing the specimens for these tests, it was found necessary, when making mixtures containing more than 27.5 per cent. of water, to increase the proportions 10 per cent. in order to fill the molds. This indicates an increase in density, which was obtained at a loss of strength. However, in some cases this is highly desirable. Often bulk and impermeability are the two requisite features. In reinforced concrete structures a moderately wet mixture is far more practical than a dry one; but it must not be forgotten that the use of wet mixtures increases the cost of materials. An increase in density means a corresponding increase in raw materials. The additional water weakens the concrete, and therefore a richer mixture or lower unit-stresses must be used. The former is preferable, for the beams and columns in concrete building are always heavier than the corresponding members of steel or wooden structures.
>
> If a wet mixture is used, the engineer should be cautious in permitting the removal of the forms at an early date. In some of the tests the wet mixtures were very slow to develop their strength. The use of such consistencies in practice would necessitate extreme care. It might be a month or more before the forms could be struck with any feeling of security.
>
> The question of consistency is not altogether a laboratory question. The increased cost of materials due to the use of wet mixtures may be more than balanced by the saving in placing; but the engineer should bear in mind that consistency has a direct relation to strength; and, if he permits a wet mixture, he should provide for the same in his design. In any event he should control the details of the mixing.

How to Erect Small Concrete Buildings

(Contributed)

THE present insistent demand for the substitution of durable, sanitary and fire-resisting materials for those not possessed of these properties has been a pronounced factor in hastening the adoption of concrete. The change means impervious and monolithic structures as opposed to those consisting of the more familiar types of masonry with their attending wooden features of combustible nature, the latter also affording refuge for much that is noxious and unsanitary. This enduring method of construction is now applied to all parts of buildings in order that there may be a practical elimination of maintenance cost.

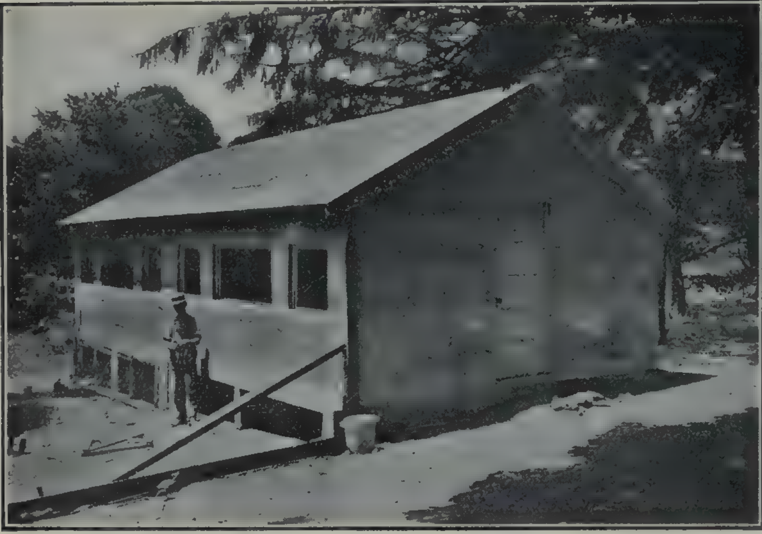


Fig. 1—A Concrete Poultry House. This building rests on concrete piers and has a concrete floor, partition and walls. The walls are only 4 inches thick.

Small buildings for one purpose or another are always required upon the farm. These structures include poultry houses, hog pens, smoke houses, wagon houses, garages and buildings designed for storage purposes. If they are built of masonry or frame, the services of experienced workmen are usually required unless the structures are of the rudest type. The purpose here is to describe briefly a method of constructing, without the aid of mechanics, small concrete buildings for some of the uses specified. Dimensions may be increased or reduced as occasion requires. Where enlarged upon and supplied with proper conveniences, a building of this character would answer admirably for a small residence. If the natural color of the concrete is objectionable, it may be coated with a wash in any color desired, thus making these small structures a picturesque as well as useful appurtenance to the main buildings of the farm.

Let it be assumed that the building is to be 8 feet wide by 12 feet long with a height to the eaves of 7 feet, inside dimensions. A building of this size might be suitable for several of the purposes mentioned above. The foundation should be 12 inches wide and 3 feet deep, which will carry it below frost line. Mark on the ground a rectangle 7½ feet wide by 11½ feet long. Outside of this rectangle mark a larger rectangle 9½ feet wide by 13½ feet long. This will leave a space of one foot between the lines all round. Dig between these lines to a depth of 3 feet. This forms the foundation trench. The concrete for the foundation should be mixed in the proportion of 1 part Portland cement, 2½ parts sand and 5 parts stone or gravel. Fill in the foundation trench with concrete to ground level, being careful to prevent earth from the trench walls from falling into the concrete. The top of the foundation should be brought to the surface of the ground and made perfectly level. To insure this test it with a carpenter's spirit level.

The walls of a building of this size will need to be only 6 inches thick and they should be erected on the centre of the foundation, leaving 3 inches of foundation on both sides. The forms can be made complete, and, if more convenient, can be assembled flat on the ground and then raised into position. The wall forms should be made of 2 x 4-inch studding placed upright and spaced about 2 feet apart. Upon this studding should be nailed, horizontally, 1-inch boards. These boards will be next to the concrete and must be fitted together, so as to insure a tight joint, and if it is desired to give a very smooth surface to the finished wall, the joints should be carefully matched. The forms, to prevent them from spreading, are tied by means of twisted wire passing between the 1-inch boards and around the upright studding, as shown in Fig. 3. To provide for the window openings a rough frame made of 1-inch boards, 6 inches wide, should be set in the forms at the proper location. Sometimes, after the forms have been filled with concrete to the height of the windows, the window frame itself is placed in the form and the concrete cast around it. The open- for doorways should be made in the same manner. As soon as the forms for the walls—both the inside and outside forms—are in place and made plumb, the concrete can be deposited between them. The top surface of the concrete previously placed in the foundation should be rough but thoroughly clean and very wet in order that a good bond between the concrete in the foundation and the concrete in the wall will result. To prevent the development of cracks in the walls it is a very good practice to reinforce them with fence wire or light rods, running in both directions. This is not absolutely necessary, however, for a very small structure, but in any case it would be well to place in the corners where the walls join, light rods bent in the shape

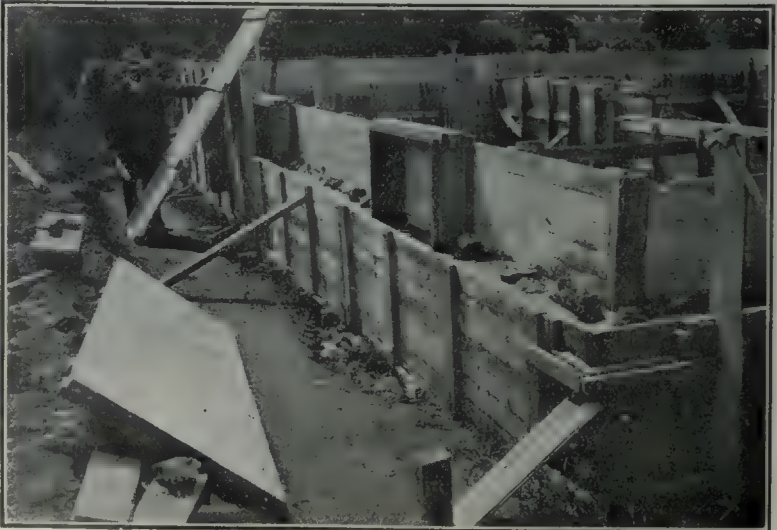


Fig. 2—Sectional form for concrete wall construction.

of an "L." These rods should be 2 or 3 feet long and placed about every 12 inches of height. The frame for the doorway should be placed in position before the concreting is started. It is sometimes the custom to tack lightly to the door frame a strip of wood tapered so that its larger side is in the concrete. When the rough door frame is removed this strip remains in the side of the door and can be used for fastening the door hinges. Some prefer to dispense with this strip of wood. They drill directly into the concrete wall in providing for hinges.

The concrete for the walls should be mixed mushy wet and in the proportion of 1 part Portland cement, 2 parts sand and 4 parts stone or gravel. In placing the concrete spade it thoroughly with a thin board paddle, thrusting the latter between the forms and the concrete in order that the stone or gravel may be forced away from the forms, which will leave a smoother surface than would otherwise result. This not only allows the rich mortar to flow against the forms, but prevents the formation of air pockets and projecting stones at the surface of the wall. It will be found convenient to place the concrete until it reaches the height of the window-sill. The window frames are then placed and the concreting continued until the height is about 2 inches above the top of the windows.

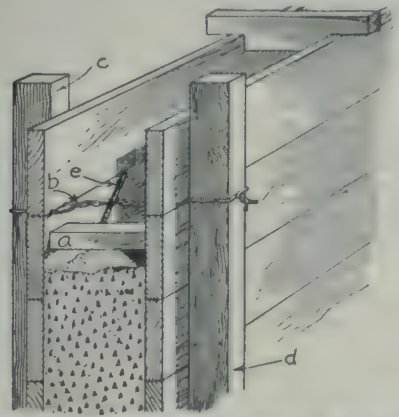


Fig. 3—Method of tying forms with wire to prevent them from slipping.

Then, in order to strengthen the concrete over the window openings, lay two ½-inch steel rods over each window. These rods should be long enough to extend about a foot on each side of the window space. In a similar manner rods should be laid over door openings, these rods to prevent any cracking of the concrete over the openings. The balance of the concrete is then deposited until the height of the eaves is reached.

On the top surface of the wall there should be imbedded vertically in the fresh concrete ½-inch bolts with the heads down. These bolts extend about 12 inches into the concrete and about 6 inches above. They can afterwards be used in fastening down the wooden sill to which the rafters are attached, if the roof is to be constructed of wood. Either a flat or a peaked roof can be used. If a flat roof, it is sometimes the practice to arrange for rectangular pockets in the top of the walls, into which the roof beams can be set. When a flat roof is to be constructed make one side of the building lower to provide sufficient pitch for drainage. The forms for the walls should be left in place about one week and no weight should be placed on the walls for three weeks or one month.

If a concrete floor is desired, proceed as in the case of sidewalk construction, that is to say, put down a layer of cinders or gravel and place over this the concrete pavement. Make this of a $1:2\frac{1}{2}:5$ mixture of Portland cement, sand and stone. To prevent the concrete pavement from cracking divide it into sections or slabs, say 3 or 4 feet square, being sure that the joints extend entirely through the concrete.

If a wooden floor is preferred, the beams or stringers may rest upon the 3-inch projection of the foundation walls.

Bonding Asphalt to Concrete

AMONG the several problems to be met in the recent construction of the concrete reservoirs in San Francisco, Cal., was that of bonding asphalt to concrete. According to B. N. Abbott, in a letter to The Engineering Record, after making unsuccessful attempts to apply the asphalt direct to the concrete in various ways, the expedient of first painting the surface with coal-tar was tried; and it was found that when applied in this way under right conditions, the asphalt would adhere so firmly that after it had cooled it could not be broken away without bringing pieces of concrete with it.

Mr. Abbott states that in order to secure this result, the concrete surface was first scrubbed clean with a bristle brush, and over this a thin coating of hot coal-tar was "painted." The coal tar should be heated in small quantities, brought just to the boiling point, and then applied immediately. Heating the coal-tar in large quantities, which necessitated some delay before it could all be used, did not give such good results; and the gangs were therefore not allowed to heat more at a time than they could apply quickly as soon as it began to boil. The asphalt was spread over the tarred surface in the usual manner.

The use of cement as an anti-sand blast is possibly one that is little known. The sand blast in question, however, is not that which is so familiar to all of us, but is quite of another type. When locomotives stand under steel or iron bridges or viaducts, the blast from the stacks throw out gases and numerous small particles of ashes and coal. This when continuously projected against the overhead iron or steel gradually causes its disintegration. In this case cement was tried and not found wanting, and now it is common practice for railroads to cover the bottoms of their bridges with wire netting or metal lath covered with a coating of sand and cement which it has been found resists perfectly the attack of the gases and also the sand blast coming from the locomotives.

The Canadian production of all kinds of finished rolled iron and steel in 1913 amounted to 967,097 tons, an increase of 105,873 tons, and also was the largest in the history of the industry in Canada. Of this, 95,881 tons were iron and 871,216 tons were steel.

Piles of the "cast-in-place" type, made by forming a hole in the ground and filling it with concrete, may be either plain or reinforced, depending largely upon the character of the work for which they are to be used. They are usually without reinforcement.

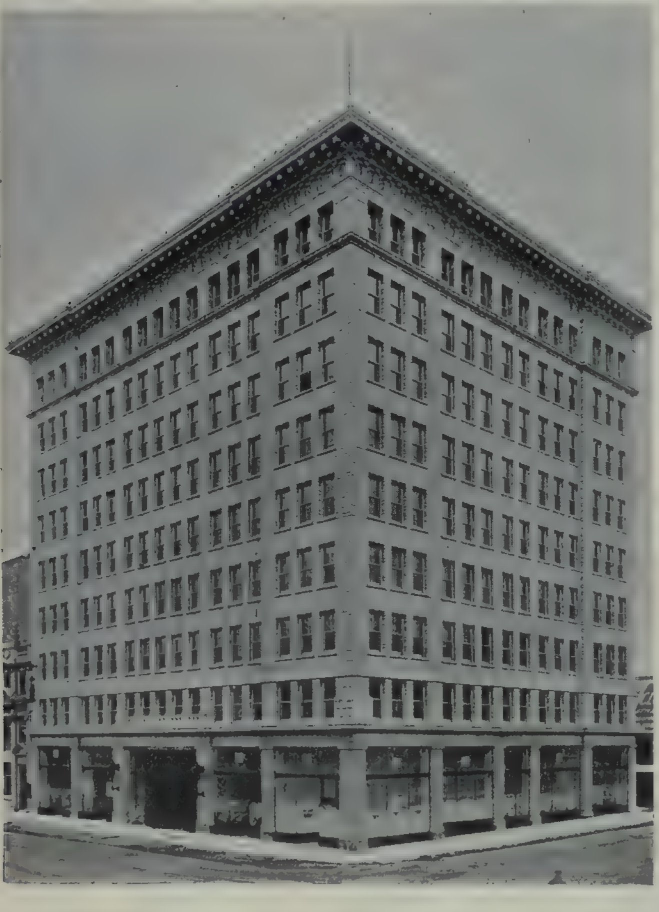
Excess of water is detrimental to concrete, as it brings a layer of cement which has already set to the surface, forming a point of weakness in the finished work, unless it is well scraped off before the next layer is deposited.

Two Noteworthy Additions to Edmonton's Business Section —the McLeod Block and the Williamson Building

WE illustrate herewith two buildings which have taken their place recently in the business section of the city of Edmonton—the McLeod Block and the Williamson Building. The former is owned by Mr. K. A. McLeod, and was built by Messrs. Olsen & Johnson according to plans prepared by Mr. John K. Dow; the latter is owned by Messrs. S. W. & R. T. Williamson, and was built by Messrs. Nesbit & Miller under the direction of Mr. E. W. Moorehouse, architect.

The McLeod Block

The McLeod Block is situated on the corner of Rice and McDougall streets. Its frontage on McDougall Street is 118 feet and on Rice Street 100 feet. The building contains nine full storeys, including basement and attic. The height from McDougall Street to the top of the cornice is 115 feet, and it is entirely of fireproof construction. The outside finish is in cream brick and plain terra-cotta, with half cornice over the eighth storey and full cornice in classic style over all. The entire cost of the building is approximately $600,000.



McLeod Block, Edmonton, upon completion.

The main entrance, which is on McDougall Street, is 28 feet wide, while the vestibule doors are seven feet back from the street. Two fine bronze electroliers have been built in the portals at each side of the entrance, one being fixed in each portal. Each is seven feet in length and is shaped to give a torch effect. The vestibule is ten feet wide and has two pairs of double entrance doors. In each side of the vestibule is a small shop. The lobby, which is 13 x 22 feet, is entered from the vestibule, and three elevators are at the rear wall of the lobby. Three high-speed elevators, built by the Otis-Fensom Company of Toronto, of the overhead traction type, each having a speed of 500 feet a minute, have been installed. The cars are 5 ft. 6 in. by 6 ft. The elevator enclosure is decorated by ornamental iron and wire glass.

A marble stairway ascends from the front to the second floor, the rail balusters being of ornamental electro-plated iron. The stairway is 3 feet 8 inches wide. The ceiling of the first storey is 17 feet 3 inches in height.

The main entrance is entirely finished in marble, with ornamental panelled ceiling. The pilasters and rails are of Italian marble. The panels are of Pannazzo Italian marble. The stair treads and platforms at the elevator landings and borders in the corridors are of light grey Tennessee marble.

There are five stores on the main floor—four on McDougall Street and one on Rice Street, one of which is 20 feet in width. The two stores fronting McDougall Street, south of the main entrance, run through to the rear of the building, with entrances on the private lane to the rear.

The floors from the second to the ninth inclusive are of the same general plan, but alterations are being made to suit tenants. A light court occupies the southwest angle of the building above the first storey, so that every office has outside light. There are nineteen offices on each of the eight upper floors, making 152 in the building. Of these, three on each floor are equal in area to three rooms each. The corridors are 7 feet in width and the ceilings 9 ft. 10 in. in height. All floors are of terrazzo. The corridors are wainscoted to the height of the doors with English vein Italian marble. The doors and the door and window frames are the only wood used in the interior of the office floors. The rear windows all have metal frames and polished plate-wire glass. The front windows are of heavy plate glass.

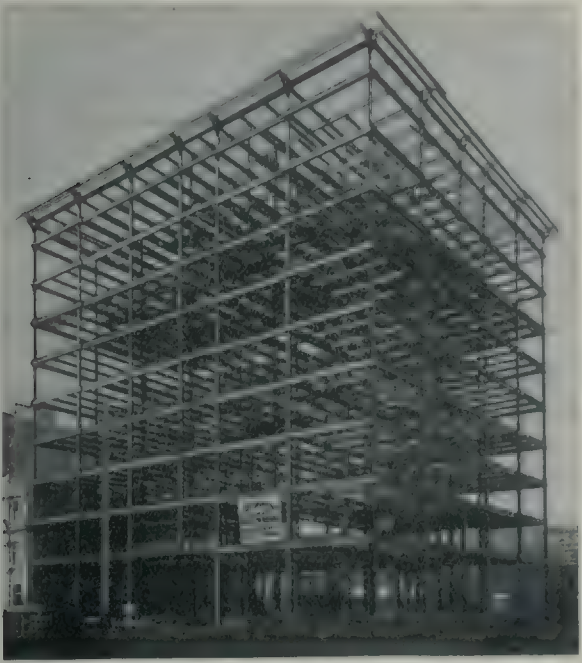
The building is steel frame, fireproofed with concrete. All structural steel members are encased in not less than two inches of concrete in the thinnest place. All partitions are of 4-inch hollow tile from the works at Medicine Hat. The construction brick was supplied by the Acme Brick Company, of Edmonton.

The basement has a 10-foot ceiling, with concrete floor and plaster finished walls. It extends under the sidewalk on McDougall Avenue and under the rear lane on the west side of the building. About three-fourths of the basement space is available for business purposes. There is an entrance from the elevator lobby on the ground floor and another from the lane in the rear. It will be lighted from both street and lane with prism glass.

Heat and power are supplied by two boilers of 300 horsepower. Electric power is generated to run the elevators, supply light to the toilet and corridors, pump water to the attic tank, run the vacuum cleaner, and such other work as may be necessary. The electric plant includes two 75 kilowatt machines with Peter Brotherhood engines, made in Peterborough, England.

The steam and electric plant is situated in the basement.

A filtration plant, which has a capacity of 7,000 to 10,000 gallons an hour, and which filters when necessary all the water used in the building, either for the boilers for fire protection, for drinking or other purposes, is also situated in the basement.


McLeod Block under construction.

A vacuum cleaner plant is also situated in the basement. It is of the Blaisdell type, and has two sweepers. Each room is connected by pipe, the dust being drawn down to the basement.

A house pump in the basement pumps water into a steel tank holding 2,000 gallons, situated in the attic. From this tank water is distributed throughout the building by gravity. The city pressure would only reach to the fifth or sixth floor. A three-inch standpipe with hose connections on every floor extends from the tank to the basement, so that there is always a water pressure available for fire purposes. In case of a serious fire a brigade fire engine can connect with a city hydrant and force water through a standpipe and attach hose to all parts of the building, the tank being shut off for the time being.

For heating purposes the building has 18,000 feet of radiation. Exhaust steam is taken from the boilers in the basement direct to the attic. The system of distribution is in the attic. Live steam can be turned into the radiators if necessary, or exhaust steam can be allowed to pass off by a pipe through the roof. A complete system of outdoor fire escapes is provided at the rear of the building.

The Williamson Building

The Williamson building has a frontage on Jasper Avenue of 48½ feet, with a depth of 112 feet, and is four storeys high, although the foundations are made to carry a seven-storied building. The same arrangements apply to the heating system. The Kahn system has been followed. All modern improvements have been utilized in construction. The building is cleaned by the Tuec vacuum cleaner, the first of these installations to be used in a business block in the city. The second storey is devoted entirely to offices, while on the third and fourth floors the offices go as far back as the stairway, the balance of the space being devoted to bachelor suites.

In order to make the building absolutely fireproof the new type of Turnbull elevator has been installed, with enclosures made of steel and wired glass. The walls in the corridor are of tile and terrazzo, with a marble base and wainscotings. The stairways are cast iron and steel, with slate treads. They were made in Edmonton by the Western Foundry & Machine Company. The same company installed the fire escapes. The platforms of the fire escapes are reinforced concrete, supported on steel columns. They are wide and made easy of descent, with hand rails on each side of thesteps.

In the basement there are two large, well-lighted and ventilated rooms, a janitor's residence, a storeroom, boiler room and coal bin.

On the ground floor there are two stores with plate-glass fronts, two rooms in the rear which can be used for stores, offices or wholesale sample rooms.

On the second floor there is a fireproof vault. This has been equipped with steel lockers for the convenience of the office tenants, who by this arrangement are relieved of the necessity of providing themselves with safes.

On each of the third and fourth floors there is a similar vault. The bachelor apartments all have private baths, and there is a public shower bath on the third and a public tub on the fourth floor. These apartments are so arranged that they my be turned into offices when desired.

All the offices are supplied with running hot and cold water. The garbage disposal plant will do double duty: it will burn the refuse and heat the water for the baths. The whole building will be heated with a vacuum steam system by two return tubular boilers, which are of sufficient capacity to heat the whole building when the seven storeys are completed.

The floors of the toilet and bath rooms are of tile.

The new Williamson Building at Edmonton.

with tile wainscotings. The floors in the office suites are covered with cork carpets, which has been pasted to cement floors and made fire and sound proof.

From the distributing panels in the corridors the telephone and electric light wires enter the various rooms via a system of pipes. Thus there are no exposed wires about the building.

The entire front of the building is constructed of ivory white mat glaze terra-cotta, furnished by the Washington Lime & Brick Company. The sides and rear are veneered white sand-lime brick, made by the Alsip Brick Company, of Edmonton. The walls are lined with Dennison's interlocking hollow tile, used here for the first time. The partitions throughout are of hollow tile and gypsum blocks. The store fronts are fitted with plate and prism windows with metal frames of a statuary bronze finish. The interior finish throughout is of selected quarter-cut and plain oak finished in natural color, and was supplied by W. H. Clarke & Company.

The store front, which is known as the Kawneer metal store front, was supplied and erected by the J. H. Lavalee Company, Limited. The vault doors were furnished by J. J. Taylor. There are eighty fireproof windows, manufactured by the Freeze Sheet Metal Company, and the Corkolium used was furnished by James Ramsey. Depew Hillas carried out the electrical work.

Causes of Concrete Failures

Analytical Study of a Problem of Much Interest to Cement Users and Contractors—Abuses that May be Avoided

By R. S Greenman

CONCRETE is said to be its own best inspector, and it is a well-known fact that defects in concrete will sooner or later make their presence known. For every fault, there must be a reason. The reasons for poor concrete have been proportioned as being 90 per cent. due to poor workmanship, 8 pr cent. due to poor aggregates, and 2 per cent. to poor cement. These percentages are not the result of tabulations, but are those prevailing in the minds of many who have had considerable opportunity for inspection of concrete, both good and bad. But whether or not these percentages are correct, the statement raises the question, "What are the reasons for poor concrete and how do we determine these reasons?" It is a certainty that neither a laboratory test nor a field inspection alone will give them, unless, of course, it be a simple failure. Yet there are people who will examine a piece of concrete in the laboratory and offer a solution of the problem simply by tests made there. And again, an inspector will look over a piece of concrete construction, and, with no knowledge whatever of the characteristics of the materials used, nor of the method of making, will attempt to tell how such and such a condition developed. Concrete failures can be explained only after thorough investigation by men who know good or bad concrete from long and close acquaintance, and whose minds are of an analytical and judicial temperament.

The more one sees of concrete, the more one becomes convinced that it is the most abused structural material being used. The science of making concrete has been looked upon too generally as being very easily learned, with the natural result that a great deal of poor concrete has been made. Now, however, builders, contractors, and engineers apparently desire to make concrete that will meet the standard in quality required of other materials; and yet, with all the precautions now being taken, there is still a large amount of concrete that is not satisfactory. The larger the work, the greater the care taken; and, vice versa, the smaller the work, the greater the carelessness, and the greater is the ratio of the failures, and it is the sum total of these failures that makes the loss caused by poor concrete so great.

In trying to solve a problem of poor concrete, the elements to be investigated are the three already mentioned—cement, aggregates, and workmanship—and water. The common tendency is first to place the blame upon the cement; but if we find that in accordance with good and generally common practice, the cement has been tested and has met the standard requirements, the cement then becomes a negligible factor; but if it has not been tested, it must be considered as a possible cause, and it may become a large item in the study. We must admit that since so much stress has been laid upon the value of having cement tested before use, and since it must indeed be a small work where it has not been so tested, the percentage of failures due to poor cement has been reduced to a very small amount.

If the next element has been given equally as thoughtful consideration to its use, there could not be so much poor concrete due to poor aggregates. The strong and weak points in both the coarse and fine aggregates have been too often neglected. The coarse aggregates can usually be judged by easy inspections, but sand or other fine aggregates need very careful examination. The characteristics of sand—such as the grain, the grading, the cleanness, and its freedom from organic impurities and excess of loam—are items of knowledge which are obtainable mainly in the laboratory, but which are very essential for the correct diagnosis of a concrete failure.

The effect of workmanship is by far the largest factor, and in it all others are included, for a poor workman can destroy the value of the best materials. Under the head of workmanship, must be considered such items as design, proportions, placing, and actions resulting from heat, frost, electrolysis, etc., which should have been taken care of during the process of making and preservation.

As another element of importance, it must always be kept in mind that the water used in making the concrete, or which may come in contact with it, may prove to be a very influential factor for harmful results.

Then, if one is given a concrete failure to diagnose, one must look for a reason under cement, aggregate, workmanship, and water. As stated, the easiest explanation is to look for some fault in the cement; but if, as has been suggested, the cement has passed the usual tests, then other reasons must be found. To find

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Abstract of a paper read before the American Society for Testing Materials.

them requires that the investigator shall first know conditions and causes of failures, but these will not be further discussed except to point out the way to the reason; then the investigator must attack the problem with an open mind—that is, he must not jump at a conclusion and expect to be able to work out an explanation around that conclusion. Then it is even more essential that the investigator shall have had an opportunity to learn of results of tests, or to make tests that will enable him to judge the probable actions from the characteristics of the aggregates. Also, a very careful examination of the concrete in place is generally an absolute necessity.

To attempt to outline a plan for procedure in this examination would be folly, since each individual case has conditions that are decidedly its own, and the law of probabilities makes possible many combinations of causes which can be worked out only as one would solve any involved research problem. Clues must be sought, and a sharp eye, a quick ear, and a questioning tongue must be alert to grasp a clue and pursue it to a definite ending. If any one should be skeptical of the efficiency of this method, it is possible that a few illustrative cases, selected from a large number of diagnoses, may convince that one that the method has proven and can prove successful, far more than in generally expected.

Failure Due to Water

A highway was being built, and the plans called for several new concrete culverts. All but one of these culverts "set up," or hardened, nicely. This one did not; and yet the same cement, sand, and stone had been used as in all the other culverts. A reason for the failure of the one culvert was desired.

It was found that the brook which flowed through this particular culvert passed in its course the plant of a company engaged in the manufacture of medicine from herbs. The refuse from the plant so loaded the water with organic matter that it prevented a proper hardening of the concrete. No one connected with the construction of the culvert knew that water so contaminated would have that effect, and the complaint came in that the cement was not acting properly. The brook was temporarily diverted, other water was used, and the concrete acted normally. A condition had existed there which would not have existed in city water, but which is found frequently in the country, especially in wooded sections. To detect the cause, one had to know that certain elements, such as tannic acid, alkalis, salts, etc., foreign to most waters, do affect concrete.

Failure Due to Sand

For an illustration of the effect of a poor quality of sand, consider the following case:

A cry of alarm came in from an engineer that the concrete is an important bridge abutment had been in place for over two weeks, and that in attempting to remove the forms it was found that the concrete was still so soft that it could be cut out with a knife. A brand of cement new to the work had been used; and the blame was, of course, placed on it. An examination showed that a footing for the abutment had been made of the brand of cement first used on the work, and that, although ten days older, the concrete could easily be cut with a knife. The evidence eliminated the cement.

Examination of the sand showed it to be a well-graded sharp sand, but a clue was furnished by some yellow-coated grains. The investigator had already had considerable experience with similar sand grains. A trip to the sand bank showed just what he expected to find. The bank had not been stripped of a top layer of yellow-coated sand, which gives a sand with which it is mixed a tendency to delay very materially the hardening of the concrete in which it is used. In time, usually several months, the concrete will harden, and there is ultimately no harmful effect apparent. Lack of knowledge of this peculiar quality has caused an investigator of another piece of work to tear it out and rebuild.

Failure Due to Stone

A very unusual condition existed in another case, but it emphasizes strongly the need of following clues. A concrete wall was apparently disintegrating, due, as the engineers believed, to free lime in the cement. In various places on the face of this wall, there appeared what can best be described as "blisters." By prying off these blisters, there were produced small cones about 6 ins. in diameter and 3 ins. n height; and in the apex of each could be seen a small, yellowish-white spot about the size of a small marble. The trouble was clearly not a case of free lime in the cement. One unusually large blister enabled the author to dig out from the apex a soft stone about 1½ ins. in size. This stone did indicate the presence of free lime, and, after a few weeks on the author's desk, slaked into a powder. Examination of the stone composing the coarse aggregate soon brought out the following:

The crushed stone all came from the same quarry, but some came by a steam railroad and some by an electric railway. No concrete made by the former showed blisters. Concrete made from stone delivered by trolley did, but why? It seems that in the course of transportation by the trolley route, the stone was conveyed in waste dump-cars, across the grounds of the company owning the quarry and conducting a plant in which limestone is an essential raw material. These dump-cars had not been cleaned carefully, and to the good stone were added some small quantities of stone that had been through a chemical process and were on the verge of disintegration. In the concrete their expansive force blistered the face. By forbidding further deliveries by trolley, the trouble was stopped.

These may be considered extraordinary cases, but it is the out of the ordinary that makes trouble; if they were not the extraordinary, they would probably have been guarded against. They are, at least, typical of points for which one must look, if one would explain failures in concrete.

Failure Due to Workmanship

Failures due to poor workmanship are seen so often that, instead of citing particular cases, it will be sufficient to note briefly some causes or results.

Failures from faulty design are shown in the mode of failure. The lack of proper proportioning may be clearly seen in a fractured surface; the grading of the aggregates is also similarly noted; and poor mixing and improperly placed concrete readily show themselves. All these are evident to an eye trained to know good or bad concrete. The failure to take care of laitance is made apparent by the seams that are bound to result from such a failure.

A concrete may be dense but not sound and hard, and "sounding" with a hammer will show up this characteristic. Too wet a mixture with fine sand or silt or a crushed dust used as fine agregate, may be a cause. It may be sound and hard, and yet may be poor for certain uses because it is too porous. By scratching the face of unbroken concrete with a dull instrument, one may sometimes judge of proportions used, and, in its early stage, can also judge somewhat as to the rate of hardening. A pocket glass in the field, and a microscope in th laboratory, help materially in determining the density, and approximately the ratio of cement and fine aggregate to the coarse aggregates. The naked eye is all that is needed to observe concrete spoiled by sweepings of sawdust, shavings, or blocks, or by waste carelessly dropped into a form. Lack of protection to fresh concrete from the sun or unusual heat, may be noted by a "dried-out" and rapidly dusting surface; and from frost, by a flaked and scaly surface.

Influence of External Forces

When concrete has apparently been good for a considerable period and has then begun to disintegrate, the reason for the failure must be sought in the character of disintegration, whether it may be due to changes in the elements making up the concrete or to some external elements or forces that have entered into it. If due to an internal influence alone, the fact will be noticed by the granular breaking up of the concrete. If due to an external force, such forces as sea water, alkali salts, or electrolysis will be under the influence of any of them. For many years, all the failures of concrete were considered as being due to the formation of certain chemical reactions; but, as it is commonly acknowledged at present that an impermeable concrete will stand in sea water as well as elsewhere, although subjected frequently to more severe actions than other concrete, its failures are due frequently to the same causes as those of other concrete, and therefore the same examinations should give the same results. Similarly, since electrolysis is considered as a cause for the breaking-down of concrete, the liability of concrete being affected by its influence will depend upon whether the concrete comes under the influence of an electric current. If it does, then its influence needs to be examined. If it does not, then the examination should also follow the usual method.

The value of laboratory tests and analyses should not be overlooked. While perhaps not giving as definite information as a field inspection, they should be used to the fullest extent to help establish the strength or weakness of a reasonable theory for the cause of failure. Where time will permit, laboratory tests of concrete made of the aggregates under as nearly as possible the same conditions, will give results that should aid in determining the fault in the original. Test specimens so made and treated should give practically the same results, and, when compared with test specimens made under ideal conditions or with standard materials, should give the investigator the reasons for the failure.

All means possible should be used by an investigator in making his examination; and his conclusions must be drawn only after he has considered the failure from every probable cause with reason and fairness. The object of the examination is either to place responsibility or to guard against failures, and right conclusions are the only ones that should be drawn if justice to either object is to be given.

Washes of diluted hydrochloric, acetic or oxalic acid may be used to remove efflorescence, the proportions being from 1 part acid to 4 parts to 8 parts of water.

Water sterilization in Detroit cost $5,150.31 for the year ended June 30, 1914. This is equivalent to 12½ cents per 1,000,000 gals. An average of 1 part of available chlorine to 3,000,000 parts of water was used.

Some Concrete Pointers

Care must be taken to see that the concrete and the wet forms are not allowed to dry out when salamanders or other artificial heaters are used to keep the work warm.

Concrete mixers must be kept clean. Before stoping at the noon hour the mixer should be thoroughly washed out, and again at night.

Hemlock when used for form work is liable to split in nailing and to curl on account of the moisture from the wet concrete.

Concrete columns should be poured from the center, the operation being continuous from the base to the under side of supported beam or guide.

Vaulted roofs should be laid in alternate squares, the lines of division being through the crown of the groined arches.

In the use of artificial coloring matter for coloring cement it is well to remember that the shade will always be lighter in the cured work than when freshly mixed.

In no case should fresh manure be placed over very green concrete to protect it from freezing, as it will spoil the surface of the concrete.

Shores should be properly capped with plank or scantling to distribute the pressure, especially where the shores are used to support floor slabs or beams after the forms have been removed.

A dry mixture is unfit for use in rubble concrete or concrete rubble. because it will not flow around the large stones and coat them with cement.

When the aggregate is composed of both broken stone and gravel, they should be mixed in such proportions as will give the least per cent. of voids when mixed.

Cost of Caring for Trees in Newark, N.J.

The work of planting, caring for and removing trees in the city of Newark, N.J., during the year beginning July 1, 1913, and ending June 30, 1914, as given in the 27th Anual Report, consisted of trimming 1,904 trees, spraying 10,699 trees, removing 153 trees, planting 109 trees, cementing 8 trees, digging 109 holes, installing 84 stakes and guards and treating 14 trees. Service was also rendered for private work on lawns and trees and to companies having overhead wires on the public streets, for which charges were made as follows:

Wire companies supervision	$144.00
Spraying lawns and trees	6.25
Cementing trees	34.50
Removing trees	33.75
Furnishing and planting new trees	266.68
	$485.18

The cost of the tree service for the year was as follows:

Salary of forester	$1,200.00
Labor and teams	1,576.74
Tools	11.22
New trees (107)	129.70
Woven wire	21.60
Iron guard	2.50
Lumber	12.61
Paint	11.60
Chemicals	35.79
Zinc	8.02
Expense of forester to nursery	5.00
	$3.014.78

Wood Block Pavements—Classification, Composition and Methods of Construction

By W. P. Taylor[†]

WOOD block pavements are generally considered the most modern of the standard types of pavements, and it is true that wood pavements containing the salient features of the present form of construction have only been laid for about fifteen years, nevertheless, the use of wood for paving purposes dates back over one hundred years, the first use of wood pavements being generally ascribed to Russia. Of course, these pavements were crude in extreme and bore little or no similarity to the present types of construction. Wood block pavements approximating the present pavements in appearance were first laid in London in the year 1839, and in Paris their use was introduced about 1838. Wood blocks were first laid in this country in New York in 1835, and in Philadelphia some wood pavements were laid in 1839 and 1840. It is interesting to note that in 1843 a committee of the Franklin Institute on paving materials submitted a report in September of that year on the different pavements in Philadelphia, and after detailing the conditions of certain wooden pavements on Chestnut Street, Third Street and other streets, concluded by saying "Finally, in consequence of the slippery nature of their surface, their deficiency of durability when of ordinary timber, of their expense in the ultimate, and in view of results of experience as far as they have become known to us, we are reluctantly impelled to the conclusion, that though their use may be proper in some detached situations, wooden pavements ought not at this time to be recommended as part of the general system of paving by the city of Philadelphia." From this period up to the present time wood block pavements have been constantly undergoing changes in form and in methods of construction, and although the present practice is fairly well standardized, it is, of course, recognized that many improvements are still possible, so that while the future will probably show fewer changes in the methods employed, the present forms of construction cannot be considered by any means final.

Wood block pavements now in use may be divided into three classifications: First, those of untreated hard woods; secondly, those consisting of soft woods either untreated, or merely dipped in some preservative; and thirdly, those made of treated wood block. The first form of construction is used to some extent in England and largely in Australia. The hard woods employed and which are laid in the street without any form of treatment are generally one of two varieties: karri and jarrah. These woods are both indigenous in western Australia, and are the only hard woods that have been extensively used and which give any real satisfaction in service; although it is generally considered at the present time that pavements laid with these hard woods are not as satisfactory nor as economical as those of treated woods. In certain countries other hard woods are used to a more or less limited extent, woods from Australia, Africa and South America being employed for this purpose.

The second type of wood block paving is extensively practised only in the city of Paris. In this city a wood is used known as the "pine of Landes," which is a very quick growing pine producing an open growth timber. This wood is grown in forests controlled by the municipality, and blocks cut from this wood and merely dipped in creosote or pitch are laid on some of the less important Parisian streets. The local conditions obtaining in Paris make this type of construction economical, though this method has not been found desirable in any other locality.

The third classification of treated wood block pavements is the classification in which all the wood block pavements of this country come, and the only one which will be considered further in this paper.

Selecting the Type of Pavement

A most difficult problem that frequently confronts the paving engineer is the selection of the best type of pavement for a given locality. Mr. George W. Tillson, in his "Street Pavements and Paving Materials," introduced a method of determining the most suitable pavement by the use of a table in which the different factors governing the selection, such as cheapness, durability, ease of cleaning, resistance of traffic, etc., are each given a definite weight, and by comparison of the different types and by placing each type of pavement a definite value proportionate to the weight of the factor, the pavement which is most adaptable to a given locality can be determined. It is interesting to note in his table, which, of course, is based on average conditions, that wood block pavement is given a total factor of 82 out of a possible 100, asphalt, granite and brick following in the order named. A similar table taken from the Forest Service Circular No. 141, and based upon the same factors, although the factors in this case are given slightly different weigths, shows the following values: Creosoted wood 80, sheet asphalt 76, vitrified brick 74.5, granite 71, macadam 55. Wood block is given the highest value of all the types of pavement enumerated in ease of maintenance, ease of cleaning, low traction resistance, acceptability, and sanitary qualities. It is only second to granite block in durability, and rates lowest in the list only in cheapness and in freedom from slipperiness. In other words, from these tables it may be assumed, if these factors are given their proper weighting, that wood block is the proper form of pavement, all things being considered, for most average city streets. The factors in which wood block pavements rank lowest often, however, make its use prohibitive. If a municipality has only limited funds available, its higher first cost, of course, will at times make impossible the use of this pavement, even though it may be shown to be ultimately the more economical type. Again, when the grades of a street are excessive the tendency towards slipperiness makes this pavement unsuitable.

The Maximum Grade

The maximum grade on which wood blocks may be used is largely a matter of individual opinion, but under the most favorable conditions they should not be laid on a grade exceeding 4 per cent. unless some special form of construction is employed. In the city of Philadelphia wood block is limited to grades not exceeding 2½ per cent., although the city of Pensacola, Florida, reports wood block being laid on a grade of 5.75 per cent., and Hamilton, Ont., has a pavement laid on 6 per cent. grade, a special form of construction, however, being used in the latter case.

The factor of slipperiness must also be considered in the design of pavements for any given city, for there are certain conditions of weather and temperature that make the ordinary wood block pavement slippery at certain times, this being particularly the case when a damp condition is followed by freezing, producing a thin film of ice on the blocks. If wood block were laid on all the principal streets of a city, the heavy horse-drawn traffic would, at such times, be seriously inconvenienced. For this reason it is well in

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[*] Presented before Section D of the American Association for the Advancement of Science.

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determining the character of pavements to lay out certain streets in each direction paved with granite block or other type of pavement capable of accommodating the heavy traffic under these conditions. Ninety-nine per cent. of the time, however, wood block pavement, on account of its smoothness, sanitary qualities, noiselessness, ease of cleaning, and ease and cheapness of maintenance, is unquestionably the most desirable of all pavements for the shopping or business districts of any large city. Where freedom from noise is not a factor, granite block may be substituted for wood at times to advantage, but granite block is one of the most noisy types of pavement and this factor alone is sufficient to preclude its use in most business districts, and to limit its use to such districts as are composed of wholesale commission houses or manufacturing plants. The one quality of noiselessness is occasionally the single factor which determines the type of pavement. The present administration in the city of Philadelphia has laid in the past two or three years a number of wood block pavements surrounding as many of the city schools and hospitals where conditions permitted, and it should be said incidentally that great benefit has resulted to these institutions on account of the decrease in street noises.

Many Varieties of Wood Adaptable

There are many varieties of wood which are adaptable for use in wood pavements, but only a few of these varieties are commercially available. In the eastern portion of the United States a wood which is used to the exclusion of practically every other type is one commercially known as "southern yellow pine." The standard specifications for southern yellow pine requie it to be well manufactured and free from defects and containing annular rings averaging not less than seven to the inch. This admits long leaf yellow pine, the best quality of short leaf and loblolly pine, but does not permit of the quick growing and open growth varieties in which the annular rings are less than five to the inch. Norway pine, tamarack and gum have all been utilized although little of these woods have been laid in recent years. On the western coast Douglas fir is extensively used. This wood is similar in many respects to the southern yellow pine but is a little more open in texture, the specifications for this wood usually requiring an average of six rings to an inch, as against seven for the yellow pine. In a test pavement laid under the auspices of the Forest Service in Minneapolis in 1906, in which long leaf pine, Norway pine, tamarack, Douglas fir, larch, white birch and hemlock were used, after an examination of four years the conclusion was reached that long leaf pine was the most valuable wood for use when treated in a pavement. Douglas fir was placed last in order of the woods tested. More recent examinations have not changed the original rating made in 1910. While this particular test pavement, however, shows Douglas fir to be less valuable in comparison with the other woods, it by no means implies that this material is not well adapted for wood block pavements, as it is well recognized that effective and durable pavements have been laid with it.

The Introduction of Chemicals

The function of the introduction of chemicals in the wood to be used for paving purposes is primarily with the object of making the wood water-proof. In the treatment of woods for railroad ties, for piles for use in wharves and docks, and for wood used for similar purposes, the factor of chemical preservation is an important one, for especially in piles, exposed to the action of water, the preservation from rotting action is a factor of first importance. While, however, in such cases chemical preservation is the principal factor to be considered, this is much less the case in pavements for if the wood blocks and the joints between the blocks are so treated and laid as to prevent water from penetrating the surface of the pavement, the rotting is practically negligible. While, therefore, methods which have been employed for railroad ties of chemically treating by adding such substances as corrosive sublimate, chloride of zinc, and sulphate of copper, and while these methods produce good results for these purposes, such materials are not suitable for the treatment of wood for pavements. The materials used to impregnate wood blocks are three: First, creosote or dead oil of coal tar; second, coal tar pitch or coke oven tar pitch (generally mixed with creosote); third, water gas tar pitch.

Creosote oil or dead oil of coal tar is obtained by the distillation of tar from coal gas and coke oven plants. It should be stated parenthetically that real creosote is produced by the destructive distillation of wood, and that what is termed creosote in the trade of wood preservation contains actually no creosote whatsoever. It is produced both in this country and abroad, although two-thirds of the total amount consumed are imported at the present time. It is characterized by its specific gravity which runs between 1.03 and 1.08, by the high proportion of naphthaline present, 25 to 40 per cent., by the presence of tar acids, and by the absence of free carbon. Until within a few years ago this material was used exclusively for the treatment of all wood for paving purposes, and is still used almost exclusively in Europe. While there is no question but that this material will give satisfaction under most conditions, the high percentage of naphthaline which will volatilize more or less readily on exposure to air tends to reduce the permanency of the water-proofing, thus rendering the wood liable to failure under certain conditions. Some ten or twelve years ago a process was devised and used extensively for treating the blocks by what was known as the creo-resinate treatment, consisting first of a mixture of equal parts of creosote and resin, which was afterwards reduced to a mixture of 75 per cent. creosote and 25 per cent. resin. The high cost, however, soon made this treatment commercially prohibitive. Experimenting along the same lines, a mixture was developed which produced practically the same effect as the resin. This mixture consisted of the addition of coal tar or coke oven pitch to the creosote. Coal tar pitch is a heavy-volatile substance low in naphthaline, but one which makes the blocks even more water-proof than the pure creosote. This mixture, or what is incorrectly often called heavy creosote oil, is characterized by a specific gravity of from 1.10 to 1.14, by a low percentage of naphthaline, from 10 to 20 per cent., and by the high amount of free carbon, from 3 to 3½ per cent.

The third material employed—water gas tar—is produced by the refining of the tar from water gas plants. It is essentially similar to the coal tar oil mixture except that it contains less naphthaline, practically no tar acids, and little or no free carbon. The records of paving data unfortunately are such that it is not possible in many cases to ascertain or determine the origin of the materials used in the treatment of the wood, but certain pavements in which the greater part of the material was derived from water gas plants have been laid, and at this writing there is no appreciable difference between these pavements and those laid with the coal tar pitch. Principally on account of the absence of naphthaline, most manufacturers who use water gas tar add coal tar pitch to the mixture. There seems to be, however, theoretically no reason why this pitch should not be used exclusively when mixed with creosote, as it is questionable whether the presence of naphthaline and tar acids are necessary in wood pavements. The differences, however, between these three classes of treating materials are so comparatively slight that the most recent practice in specifications is to permit the alternative use of all three types, for while under certain conditions one material or another may be more suitable, the difference is not sufficient to warrant the exclusion of the other type, and thus decrease competition.

The amount of preservative required in wood block has not yet been definitely determined, present specifications requiring from 16 to 20 lbs. per cubic foot. Average present practice requires 16 to 18 lbs. of oil to the cubic foot on heavy traffic streets, and about 2 lbs. more oil on lighter traffic streets. There has been a distinct tendency, however, in the past year or two towards decreasing the amount of oil required, and it is questionable whether this amount cannot be satisfactorily reduced to only 12 or 14 lbs. The amount of preservative per cubic foot is determined at the plant by measuring the creosote tanks before and after the treatment of the change in each cylinder, and also by determining the weight of a certain number of measured and weighed blocks before and after treatment. The amount of preservative in wood can be roughly determined by extraction, though the methods are uncertain and the results at best are only approximate.

The essential features of wood block pavement constructions are by no means as well standardized as are most of the other types of pavement. It is, of course, always conceded that wood block should be laid on a concrete base, the most frequently used base consisting of a 1-3-6 concrete, from 5 to 8 inches thick, depending upon the width of the street and the character and amount of traffic. Wood block pavements are laid usually at a cross slope of ¼-inch to the foot, or 1:48, which, however, varies with the longitudinal grades.

The Cushion Course

One of the most important details on which engineers cannot seem to come to a definite agreement is in regard to the construction of the cushion course, which is laid between the concrete and the wood blocks. There are three methods used in the construction of this cushion course, consisting of first, a cushion of plain sand, second, of a mixture of sand and cement laid dry, or merely dampened, and third, a regular cement mortar cushion. The principle to be considered in the design of a wood block pavement is to provide for protection of the bottom of the wood blocks from water, for wood only absorbs water along the length of its fibres, which in a pavement run perpendicular. The upper end of the wood fibres which form the surface of the pavement are so packed down and compressed by traffic that there is practically no danger of absorption from the upper surface. The weak point, therefore, in a pavement is the bottom of the block and the cushion and the joints must be so arranged as to absolutely protect the bottom of the block from the presence of water. If a sand cushion is used it will be seen that the cushion itself presents no resistance to the attack of water, and when this form of cushion is employed reliance must be placed exclusively on the joint filler for protection. Anyone with paving experience will know it is practically impossible to lay a pavement with perfect joints, and even if they are originally made perfect, openings in the street and other causes will in time break the bond in the joint, thus leaving, when a sand cushion is used, means of access for water to the bottom of the blocks, and hence endangering the construction. Under certain conditions, and especially under extremely heavy traffic, a plain sand cushion may be used, but it is at best a questionable design.

The dry cement mortar is the type of cushion most frequently employed. In this construction a dry motar, mixed usually in the proportion of 1 part cement to 4 of sand, is laid, rolled and struck to a depth generally of 1 in., and immediately before the block are laid the cushion is slightly dampened by sprinkling. The blocks are rolled as soon as laid and before any set develops in the mortar. This type of construction is probably the best of the three types for the reasons that the dry cushion, which is more or less elastic, permits of the ready bedding of the blocks to different depths, and the presence of the cushion course makes repairs and maintenance more simple. The theory of this cushion course is that if any water does penetrate to the cushion it will immediately attack the cement in this cushion and that the cement will then harden and thus prevent the absorption of water by the block, this theory apparently working out well in practice.

The method of laying block on a wet mortar cushion is less extensively practised, for by this method the adjustment of any inequalities in the pavement when blocks are being laid is more difficult and maintenance repairs are harder to make. It is a question also whether this cushion prevents the attack of water as well as the dry cushion, for if there is any displacement of the wood blocks in this form of construction, the blocks become detached from the course and thus permit the absorption of water, whereas in the more elastic dry mortar construction the activity of the cement does not begin until water is actually attacking the block, and at that time, therefore, the cushion is in close contact with the block, and thus in a position to produce the most effective results.

The depth of wood blocks is fairly well standardized at 4 in. A greater depth of block being uneconomical even in the heaviest traffic streets, and a lesser depth not giving sufficient stability to the pavement. Three and three and one-half inch blocks have been used on certain light traffic streets, but the use of these smaller blocks is not generally recommended unless there is great necessity for economy in first cost.

A number of different materials are used for fillers in the joints between the blocks, the most common being sand, mortar, pitch and bituminous material. From the preceding statement relative to the cushion it will be observed that if there is thorough protection on the bottom of the block, the necessity of protection from water on the sides of the blocks becomes practically insignificant and for this reason the tendency of present practice is to employ only the plain sand filler. A grout filler is the poorest form of construction for this filler has no expansive quality, and the ordinary expansion and contraction of the pavement will soon destroy the effectiveness of the joint. A filler of pitch, or mixture of pitch and creosote, or an asphaltic filler, is entirely unobjectionable, but if the mortar cushion is used it is a useless expense to have this additional protection. If, however, a sand cushion is employed it is absolutely necessary to use some such joint filler, the best being an asphalt filler such as is used in the expansion joints. In certain localities joints have been made by filling the bottom half of the joint with gravel and the upper half with pitch or asphalt, but while such a joint filler might be a desirable construction for a granite block pavement under certain conditions, it is almost impossible to see the advantage of this method for wood block.

In the few wood block pavements that have failed this result usually is due to expansion caused either by improper treatment or by faulty construction in not providing sufficient room for normal expansion. The expansion and contraction of wood pavements due to changes in temperature is small and for practical purposes almost negligible, but the expansion of the pavement due to the absorption of moisture, which can never be wholly prevented, is a factor that must be seriously considered. It is good practice to allow 1 in. expansion joints at each curb for all pavements on streets 50 feet or less in width, and for streets greater than 50 feet, a proportionate increase in the width of joint. As a wide joint at the curb is always undesirable, if joints exceed an inch, or an inch and a quarter, the best form of construction is to lay a longitudinal row of blocks along the curb, placing one joint of an inch or so between the curb and the row of blocks, and the second joint on the outside of this row. The material used in these expansion joints should be an asphaltic material which will, as far as possible, remain elastic at low temperatures and will not be too soft at high temperatures, and also one which has a minimum range of ductility between the limits of temperature that will be experienced on the street. The material, furthermore, must be soft enough to adapt itself readily to changes caused by expansion and contraction. These joints should never be filled with tar for this material becomes practically rigid at low temperatures and its value as an expansion joint filler ceases.

Blocks are generally laid at right angles to the line of the street, but recently the practice is coming into vogue of laying the blocks at an angle of 60 to 70 deg. The merits of this treatment have not, however, been definitely established and as it is more difficult to lay and repair pavements so constructed, it is doubtful whether this practice will be generally adopted as standard.

Many special devices and forms of wood block pavements are being placed on the market with the intent of doing away with some of the objections that are raised against this form of pavement, principal consideration being given to devising a form of wood block which is adaptable to steeper grades, and one which will not become so slippery in wet weather. Types of lug block, grooved block, blocks with iron cleats inserted, blocks spaced with strips of creosoted laths between them, and other types have been introduced, though as yet none of them have come into general or extensive use. When such a construction is developed it will do much to increase the use of these pavements. The city of Philadelphia, as well as other municipalities, is experimenting with these different forms of construction, but as yet is not in position to advocate any one type.

This paper does not purport to cover all the various phases and problems that enter into the construction of wood block pavements, but it is hoped that it has brought forward some of the problems that confront the engineer in relation to a pavement which is becoming increasingly popular, and which will be employed in ever-increasing amounts, as it is unquestionably the most satisfactory form of pavement for important city streets.

Canada Cement Company's Good Showing

Having regard to the adverse conditions last year, the Canada Cement Company made an excellent financial showing, the balance available for dividends being only $86,226 less, at $1,057,990, than in the previous year. The President, Senator Edwards, states that the volume of business for the past year was less than for 1913, but on account of the completion of construction work and improvements to plants, the company was in a better position to distribute its product and was enabled to make a reduction in the selling price of cement to its customers in the Province of Alberta and the western part of Saskatchewan. The directors regret that, during the year 1915, a further decrease in the volume of business must be anticipated, but notwithstanding this, they hope that the improvements made in organization, and in the physical condition of the company's plants will warrant a further reduction, in some sections of the country, in the selling price of the product. The balance carried forward to surplus is $322,990, compared with $409,217. For the time being the company has decided to halt its construction programme, which, as a matter of fact, was already nearing completion when trade began to slacken. The plant at Medicine Hat, Alberta, will not be completed until such time as conditions justify it.

Mainly Constructional

East and West—From Coast to Coast

There is talk of building a $70,000 brewery at Fort George, B.C.

The Kingston City Council is considering the question of establishing a municipal incinerator.

The Brantford Scales Company have in view the matter of building a new factory at Brantford, Ont.

In North Vancouver, B.C., the building permits for 1914 were four times as large as in the previous year.

At a recent meeting of the Winnipeg Board of Control is was decided to proceed with the double tracking of St. James subway.

The Municipality of Saanich, B.C., is taking tenders for the installation of a water-works system at Royal Oak. The estimated cost is $375,000.

Arrangements have been made for the establishment of a box and basket factory at Dundas, Ont. Messrs. Brown & Liddy are the promoters.

The Rotary Engineering Company will build a plant in Chatham, Ont., which will give employment to 55 first-class mechanics, besides other labor.

The Lost Creek Mining Company will shortly construct a flume on its property at Roany placer camp, Manitoba. The work will cost about $100,000.

The Ontario Niagara Connecting Bridge Company is applying to Parliament for authority to build an international bridge over the Niagara River.

The Peterborough, Ont., Board of Works have instructed City Engineer Parsons to prepare a report regarding different types of paving suitable for local use.

The new Union Station and railway viaduct along the waterfront, Toronto, will go on next spring. The proposed new eastern entrance to the Exhibition grounds will also be proceeded with, probably at the same time as the other projects.

With a view to forcing the Quebec Street Railway Company to extend their lines in Belvedere Ward, City Engineer Bellairge has been instructed by the City Road Committee to prepare plans for the extension of the line to the limits of the city.

At a conference of the Board of Control and the Hospital Governors of Toronto, it was agreed to proceed as soon as possible with the first unit of the new City Hospital on the mountain. It will cost $200,000 and will be a four-storey brick building.

The Butterick Publishing Company, New York City, has completed a contract for the lease of a building to be erected for them on Wellington Street, near Spadina Avenue, Toronto. The building will be 50 x 200, of steel and brick construction, five storeys, with sprinkler system.

One of the first American industries to seek a Canadian location since the war began is a New York silk concern, which will establish in Sherbrooke, Que., at once. The company will temporarily locate in the City building on Frontenac Street, which will be placed in thorough repair.

To provide for the borrowing of $16,275 by debentures to pay for a concrete pavement and curb on Queen Street East, a by-law was passed at the first meeting of the Brampton, Ont., Council this year. By-laws for $4,290 for sidewalks and $20,560 for local improvements were also passed.

The footings are in for the new building which is being erected on University Avenue, Toronto, for the Provincial Hydro-electric Commission. The building is to be six storeys high with basement, 88 x 6 feet in dimensions, of steel, terra-cotta and brick construction. The estimated cost is $200,000.

At a recent meeting of the Executive of the Grand Forks, B.C., Board of Trade, resolutions protesting against extension of time for the construction of the north fork of the Kettle Valley Railways were passed, to be forwarded to the Dominion Minister of Railways and to the Provincial Government.

The office building which is being erected at the corner of Yonge and Albert Streets, Toronto, at a cost of $100,000, has reached the roofing stage. The owners are Messrs. John Stark & Company, and the architect is Mr. F. S. Mallory. The building is of brick and terra-cotta construction and is six storeys high.

Works Commissioner Harris, of Toronto, has reported against the laying of tracks on Springmount and Oakwood Avenues and Dovercourt Road, instead of on Lansdowne Avenue, which was the original intention. In his recommendation he says that the road is longer, more inconvenient, and more expensive to operate.

It has been stated upon good authority that a large office building on Hastings Street, Vancouver, B.C., will shortly be remodelled into a first-class hotel. Plans for the new hostelry are being prepared. Tenders for the general contract will be called for in a few days. The alterations are estimated to cost about $10,000.

The Simcoe, Grey & Bruce Railway Company will apply to Parliament for an Act extending the time within which to commence the construction of the railway and expend fifteen per cent. of capital stock for two years, and for permission to complete the railway and put it in operation within five years after the passing of the Act.

The Roger's Pass tunnel which is being built in British Columbia by the C. P. R., in order to reduce its grades, will be over five miles long and costs, completed, $5,000,000. The drillers have struck rock known as Manhattan schist, which is the rock underlying New York. The Roger's Pass tunnel is being bored through Mt. Macdonald.

Work has been commenced for the construction of a high level bridge over the Humber River at Lambton Mills. The bridge is a part of the Toronto Suburban Railway extension from West Toronto to Guleph and is being erected just north of the present C. P. R. bridge. This structure is about 100 feet above the level of the river.

The bulletin relating to Water Meter Rates and Regulations received from the Buffalo Meter Company, Buffalo, N.Y., cannot fail to be of much interest to municipal men. Particular value attaches to a table giving the high and low rates of 709 water-works. The model meter regulations contained in this bulletin will be found helpful.

City Engineer Craig, of Calgary, advises us that the ratepayers, having turned down a by-law to raise the sum of $165,000 for the erection of the Louise Bridge (in reinforced concrete) it is now proposed to put up a steel structure similar to the one already existing, on the same abutments and piers, at an estimated cost of $40,000.

The exterior work on the Customs House which is being erected at Ottawa for the Dominion Government is being advanced rapidly by the general contractors, Messrs. Peter Lyall & Sons Construction Company. The building is seven storeys high, with basement, and the construction is stone and granite with reinforced concrete and brick construction.

The citizens of Chatham, Ont., decided recently to authorize the Town Council to seek power from the Legislature to issue $20,000 bonds to further increase the water supply for the town. This will be used to build a concrete reservoir of sixteen million gallons capacity, to replace the present wooden one. Chatham citizens would then have an abundance of water.

The large sum of $2,100,000 will be spent on harbor work this year, according to the estimates of the Toronto Board of Harbor Commissioners. The Commission has now all the money it needs to go ahead with the work. It recently raised $1,000,000 and had a balance of $500,000 left over from last year. Part of the work will be done by the Government and part by the Commission.

The pumps of the new water-works system recently completed at Wallaceburg were successfully used for the first time on Wednesday afternoon, January 20th, when water was turned on in the town. Pumping was continued all night and by noon on Thursday the water tower was half full. Mr. Chipman, the engineer for the work, was present. It is expected that an official opening will be arranged later.

The city of Regina is proposing to tap additional sources of water supply to meet possible demands of increase in population. There is an abundance of water available from the present artesian wells to meet all present requirements of the existing population, but Regina is profiting from her experience of several years ago when the increase in population was so great that the water-works extension could not keep pace. Mr. R. O. Wynne-Roberts is the Consulting Engineer.

His Worship Mayor Martin, of Montreal, has threatened to seek the annexation of Montreal to Ontario if a bill now before the legislature at Quebec regarding the construction of a big bridge between Maisonneuve, St. Michel Des Rapides and Riviere Des Prairies is adopted. The bridge is to afford better opportunities for the farmers to come into Maisonneuve. The structure will be of little practical value to Montreal, but the bill provides for levying the cost of the bridge on Montreal, and this has made the mayor angry.

Steady progress is being made in the boring of the tunnel under Mount Royal. As the tunnel is excavated the large concrete blocks which form the shield of the tunnel, are put into position. It is anticipated that the widening of the tunnel will be completed in another three months, and that the line will be ready for traffic towards the end of the summer. The power house at the back of the mountain is practically completed, and a start has been made with the Mount Royal Heights station. The crossing under the Canadian Pacific railway tracks has been completed.

Work on the Perth-Smiths Falls Section of the Ottawa and St. Lawrence Electric Railway will begin in the spring. It is probable the line will be diverted to run from Rideau Ferry, a popular summer resort for both Perth and Smiths Falls. The road makes a belt three hundred miles in length through eastern Ontario, starting from Ottawa to Morrisburg, along the St. Lawrence through Brockville to Rockport, across by Charleston Lake to Athens, Frankville, Toledo, Smith's Falls, Perth, Lanark and back to Ottawa. Thirty miles in the eastern section is already constructed.

In spite of the present universal building depression some interest is being evinced by Winnipeg capitalists in building projects. It is proposed to erect a $60,000 modern office building at the corner of Garry Street and Portage Avenue. A fine up-to-date fireproof apartment block is also planned for the corner of Lavinia and McGee Streets. On the site of "The Beanery" a restaurant between the St. Charles and Royal Albert Hotels on Albert Street, a fully modern restaurant and fruit store, estimated to cost in the neighborhood of $15,000 is to be erected. In Linwood a project is on foot to build a large and fully modern moving picture house to cost $14,000. Plans show provision for the installation of a high-grade air cleaning plant.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Chatham, Ont.
The Town Council will apply to Legislature for the necessary power to raise $20,000 for the construction of a reinforced concrete reservoir of 16,000,000 gallon capacity.

Exeter, Ont.
The Town Council contemplate laying watermains along Huron Street next spring. Town Clerk is Mr. Thos. B. Carling.

Hamilton, Ont.
Plans are being prepared for a pump house to cost about $59,000. Building will be of brick construction with tar and gravel roof. Tenders will be called about March 1st, including motors, pumps and equipment. The City Engineer is Mr. A. F. Macallum.

Hull, Que.
A 5-in. watermain will be extended from Reboul Street to Gilmour Lumber Company's yard for fire protection.

It is proposed to replace a 5-in. main on Laurier Avenue with an 8-in. cast iron watermain. Particulars can be obtained from the Town Engineer, Mr. J. A. Laforest.

London, Ont.
The city intend to start next spring on the laying of 4-in. to 18-in. watermains, estimated to cost $21,000. Mr. E. V. Buchanan, City Hall, is the Engineer.

An expenditure of $16.000 will be made in remodelling the pump house and installing pumps and general hydraulic equipment. Equipment will also be purchased for 700 service extensions to cost about $10,000. The Engineer is Mr. H. A. Brazier.

Niagara Falls, Ont.
Tenders will be received by Mr. W. J. Seymour, City Clerk, from February 6th to 16th for laying sewers from Second Street to and along Hamilton Street. An expenditure of about $10,000 will be incurred in this work. The City Engineer is Mr. F. J. Anderson.

North Vancouver, B.C.
Engineer A. M. West has been instructed to prepare a report on the construction of a sewer on Tenth Street.

Ottawa, Ont.
The construction of a concrete roadway between Ottawa and Prescott is under consideration. A precise line of route is yet to be adopted but the work will cost approximately $10,000 per mile. Mr. W. A. MacLean, Parliament Buildings, Toronto, is the Provincial Engineer.

Work is to start by day labor on a $3,000 sewer extension between Lewis and Gladstone Streets.

Port Rowan, Ont.
The Town Council contemplate laying a concrete pavement on Main Street. Particulars may be obtained from Mr. W. A. Mabee, Town Clerk.

Sarnia, Ont.
Tenders will be called shortly for waterworks supplies for 1915, by the city, Clerk for which is Mr. J. D. Stewart.

St. Thomas, Ont.
Estimates are in course of preparation for the construction of cement sidewalks on several streets. Mr. W. N. Ferguson is City Engineer.

Toronto, Ont.
Tenders will close on February 16th for sewers on Harriett, Ivy, Kiswick, Smith and St. Clair Ave. Specification, etc., is at the office of the Commissioner of Works, Mr. R. C. Harris.

Tenders close on February 16th for the supply of 24-in., 30-in. and 36-in. cast iron special castings. Specification, etc., can be seen at Room 9, City Hall, Watermain Extension Office.

The work of grading Conduit Street, from Indian Road Cres. to Oakmount Road, at an estimated cost of $13,021, will be proceeded with. Mr. R. C. Harris, City Hall, is Commissioner of Works.

Vancouver, B.C.
City Engineer Fellowes recommends that work be started on the construction of a sewer on Powell Street from Nanaimo to Slocan. The work is estimated to cost $6,000.

CONTRACTS AWARDED

Maisonneuve, Que.
A contract for grading and paving streets has been re-awarded to Quinlan & Robertson, 50 Notre Dame Street W., Montreal, Que., for $96,000.

Stratford, Ont.
The contract has been awarded by the city for concrete archway 9 ft. in diameter covering a portion of Erie Creek, to Mr. Walter Davis, 55 Caledonia Street, for $14,397.60. Additional contracts to the value of $18,957.75 and $17,456 have been let to L. J. Looby, Dublin, Ont., and H. T. Morris, 257 Frederick Street, Berlin, Ont., respectively.

Toronto, Ont.
The Board of Control have awarded contracts for sewer from the foot of Berkeley Street to Cherry Street, for $8,433, to D. Arnod, and for the West Toronto Sewer System Division No. 2 to Connolly Agnew Company for $28,653.

Winnipeg, Man.
A contract for five 15,000 gallon steel water tanks and three pumps and engines for the Greater Winnipeg Water District has been awarded to the Canadian Fairbanks-Morse Co., Ltd., at $7,490.

Railroads, Bridges and Wharves

Blanshard Township, Ont.
Tenders will be received by the Clerk to the Township, Mr. J. H. Jameson, Rannoch P.O., until March 1st, for the erection of a steel bridge, 78 feet span, over Trout Creek.

Hamilton, Ont.
It is expected that work on the new $50,000 subway will be commenced within a short time. The plans have been accepted by the Chief Engineer of the Grand Trunk Railway.

Hullett Township, Ont.
Tenders will be received by Mr. Jas. Campbell, Londesboro, Clerk to the Township Council, for 3,500 ft. of rock elm planking, 2½-in. thick, in 14 ft. lengths, for bridge flooring; to be delivered by May 1st.

Lambton, Ont.
Tenders will shortly be called for a bridge 650 ft. long, for the Toronto Suburban Railway Company and the Canadian Northern Railway. The Engineer in charge is Mr. E. T. Wilkie, 9 Toronto Street, Toronto.

Peterboro, Ont.
The City Engineer has been instructed to make a report on the construction of a bridge over the creek on Bonnacord Street, and also a bridge at the foot of Lock Street. Mr. R. H. Parsons is the City Engineer.

Toronto, Ont.
The Board of Control will be calling shortly for tenders for a section of the Bloor Street Viaduct from Parliament Street to Western Terminus. Work will consist mostly of concrete retaining wall in ravine. It is estimated to cost about $300,000.

The Commissioners of County York recommend that the following bridges be rebuilt and repaired: Rountree's Bridge on Weston Road near Thistleton, bridge over Mimico Creek near Islington, bridge over Tool's Creek near Brown Hill Culvert at Newtonbrook, Town Line bridge near Holland's Landing, Cold Creek bridge, and East Udora bridge. Mr. F. Barber, 57 Adelaide St. E., is the Engineer.

CONTRACTS AWARDED

St. John, N.B.
Work for laying spruce plank floors on the Suspension Bridge, for the Department of Public Works has been secured by John A. Adams, 128 Queen St. W.E.

Sudbury, Ont.
Work is to be started as soon as weather permits on the construction of two concrete bridges, to cost $12,500. The general contractor is D. L. Brown, Cedar Ave., and Messrs. Clark & Monds, City Hall, are the Engineers.

Toronto, Ont.
The contract for the Rosedale Section

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A Symposium on The Possibilities of Trade Development

> **An Empire Sentiment:**—"I Stand in the First Place for the Empire as Against the World, and Within the Empire, I Stand First for Canada."
>
> **Rt. Hon. Sir Robert Borden,**
> **Premier of Canada.**

NEVER before in the history of Canada or the Empire has there been such a fitting occasion for examining thoroughly into our natural resources the utilization of which will enable us to replace the manufactured goods of Germany and other foreign countries by articles representing the product of British labor. The movement has originated, of course, with a desire to eliminate as far as possible, for all time, trade relations with our present enemies, but even if the idea did not owe its origin to such a commendable source of inspiration, it would be an excellent one to pursue.

The status and influence of a nation are not maintained and improved by a large standing army: the wheels of commerce play a far more important part. The great German Empire was not built up by such swaggering bullies as the Kaiser and his myrmidons: it was built up by men who had a keen insight into industrial development; by enterprising manufacturers; by experimental chemists; by inventors; by industrious workmen. It is upon such a basis alone that an empire can be built up. After it has been raised to the enviable height, it depends upon a well-balanced administration to maintain its position. But that is another matter: British administration, generally speaking,, has never failed us.

And so it is that we regard as the thing of next importance to the operations that are being conducted in the actual theatre of conflict, the steps that are being taken to promote our industrial development. Hence, we are persuaded that it is an opportune time to publish a British Empire Number, and to make a special feature of a Symposium on Trade Development within the Empire.

In this symposium, the suggestions are so diversied and the contributions so numerous that it would be too great an undertaking within the compass of a short editorial article to discuss each item in detail, but in one respect—in one general respect—we venture to express a word of comment, and that is, in regard to the "Made-in-Canada" idea. When this movement has such a staunch supporter as our good friend the Minister of Trade and Commerce, whose foreword, written as a "Letter to the Editor," lends such distinction and weight to the Symposium, one hesitates to commit himself to anything that may sound like opposition, but, at the same time, we cannot refrain from saying that while in theory there may be much to commend it, in practice there are certain well-defined limitations.

We are all good Canadians, and we would all see Canada occupying a position of pre-eminence in the Empire, but certain it is that such position can only be attained by virtue of honest achievement and not by any selfish policy of Dollars First and Reputation Last. We can only expect a demand for "Made-in-Canada" goods proportionate to the high quality and reasonable prices of the various lines of manufacture.

The question arises whether the "Made-in-Canada" cry is being taken up by those who are really representative of Canada's best manufacturing interests. Supposing the campaign succeeded and it were possible to brand every article with a "Made-in-Canada" stamp, is it likely that such a brand would be restricted to high-grade products? Is it not possible that in time it would be applied to goods of inferior manufacture, with the result that both good and bad articles would finally come into disrepute, both at home and abroad? Does not our best chance of success lie in pursuing the ideal of higher standards of manufacture and the more extensive advertising of our products? Surely there is more solid business sense in such a policy!

Passing from this phase of the subject, we must compliment our contributors upon their interesting and valuable suggestions as to the further development of our natural resources, and the wider introduction of goods of British manufacture. In the compilation of this feature, we have benefited by the specialized and yet comprehensive knowledge of our readers. The possible introduction of various constructional lines had occurred to us from time to time, in a more or less remote way, but never before had we been impressed so forcibly by such an all-embracing set of ideas. We find that there are possibilities of new industries—or at least, of industrial development—in practically every material entering into the field of engineering and building construction. In regard to our natural resources, we are fully persuaded that from the Atlantic in the East to the Pacific in the West; from the Maritime Provinces in Manitoba, to Saskatchewan, to Alberta, to the foothills of the Rockies, and back again to old Quebec and to Ontario, there are valuable deposits untouched and in many cases unknown.

The statements and suggestions of some of our correspondents may be open to criticism—and it is hoped that they will be criticised, constructively, and that we shall hear from many of our readers—but taken all in all, the views advanced cannot fail to have a considerable educational value. Apart from the Minister of Trade and Commerce, our contributors include men high in office in the several constructional organizations, prominent engineers and architects, consulting engineers, contractors, manufacturers, dealers and others the majority of whom are well-informed and of wide experience.

We take this opportunity of thanking one and all for their co-operation, and of expressing once more the hope that further good works will follow them.

Niagara Power : An International Problem

THE statement* made by Mr. Arthur V. White (Consulting Hydro-Electric Engineer with the Commission of Conservation, Dominion Government), dealing with the problems arising out of the international power situation, published in our issue of January 27th, has been received with much interest, and further editorial reference to it may come opportunely at a time when we are devoting ourselves to a consideration of matters affecting the progress of Imperial trade.

Mr. White calls attention to the fact that a number of Bills relating to Hydro-Electric development on the Niagara River have been presented of late to the United States Congress. These measures contain certain provisions which cannot fail to be greatly inimical to Canadian manufacturing interests. Emphasis is given to the fact that the possibility of trouble lies not with the people, but with the aggressiveness of certain powerful United States commercial interests which are seeking to bring about the importation into the United States of increased quantities of electrical energy generated in Canada. The whole matter is set forth very clearly in Mr. White's paper, which discusses the Smith Bill and the Cline Bill (two measures dealing with the Niagara waters), which provide for the importation of electricity from Canada into the United States, and make certain provisions in regard to the methods by which water may be diverted from the Niagara River for power purposes. We are reminded that the United States Burton Act, which for years very definitely restricted both the diversion of water and the importation of electricity into the United States, expired in 1913. Under this Act Canada enjoyed some protection.

As we have said, the whole matter is covered very fully in Mr. White's statement, which commands the careful perusal of those interested in the subject, but we cannot let such an occasion as a British Empire Number pass without adding our own quota to a discussion of this character.

Canada's great power resources constitute the life-blood of her industrial progress. If we draw upon that life-blood by exporting power to the United States, without and adequate **quid pro quo,** our neighbors across the line will fatten at our expense, while the manufacturing achievements of the decades to come will suffer vastly in their proportions.

Mr. White shows us very clearly what the sentiment is in the United States. It is important to notice in his statement that he does not rest his argument upon his own surmise or conjecture, but quotes the statements of leading authorities in the United States, regarding the advisability of that country's speedily importing larger quantities of electrical energy. Brief parts of some of the quotations follow:

Lt.-Col. Sanford, reporting to Chief of Engineers, United States Army, states that,

> "If advantage of the power, generated in Canada, cannot be had on the American side, manufacturers will be attracted to Canada by the cheap power, and the industries of this country will suffer accordingly. **Manufacturers at present contracting for additional Niagara power must locate and are locating in Canada.** It therefore seems advisable to permit **immediately** the importation of Niagara power to the fullest extent permissible under the law."

Former Secretary of War, Hon. H. L. Stimson, states to the effect that if the additional electricity were not used in the States **"it would result in giving to Canada,** very possibly, **a large number of industries** which otherwise would be established on this side of the Falls."

The Sub-Committee on Niagara Falls power of the United States Congress, in their recent report upon the subject, urge that the "United States ought to get what power it is able to **now."** And the Committee further states that

> "It is proper to take as large an amount as we can get for consumption in the villages, cities, factories and homes along **our** borders."

Representative Chas. B. Smith, the promoter of one of the Niagara Bills, states:

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* The reference is to a statement made at Ottawa last month before the Annual Meeting of the Commission of Conservation.

> **"Every restriction on the importation of Canadian power should be at once removed.** Electrical power is a raw material and should be free."

Statements like the above are so clear-cut and definite that no doubt is left regarding the great value placed by the United States upon electricity generated in Canada at Niagara Falls. We thus see that there is open apprehension concerning the prospect of manufacturers being attracted to Canada by our cheap power, and how pressure is being brought to bear with a view to removing all possible restrictions on the importation of Niagara power, so as to retain and develop industries which otherwise might well establish themselves on the Canadian side of the Falls.

> "It is most definitely affirmed," to quote Mr. White, "that there is present demand for additional electrical energy on the United States side of the boundary, and, in consequence of this market, strenuous efforts, especially during the last two years, have been made to secure as large an amount of power as possible from the Canadian side. By so doing, vested interests may be created, and thus make it difficult, if not impossible, for Canada ever to use this power without the risk of serious international differences."

We do not want to contribute to the creation of any conflicting "vested interests," and we do not want to be bothered with any such complications as may arise therefrom. Further—and what is more important—we are not going to get the thin end of any deal with our excellent neighbors to the south of the line, as we have done on previous occasions in our history—especially when reasonable foresight will preserve our assets.

Many Other Problems

The Niagara power situation is not the only one we have to consider: there are questions identified with the water powers of all the provinces on the International Boundary; navigation and power on the St. Lawrence; transportation on the Great Lakes and via the proposed Georgian Bay Canal; questions of diversion and power development on the St. Mary River, Lake Superior, and on the Pend d'Oreille, Columbia and other rivers in British Columbia; diversions for irrigation on the St. Mary and Milk Rivers in Alberta. These are only a few of the many diverse subjects, which, it is gratifying to know, are being weighed by the Commission of Conservation. But the Niagara power situation, especially, is one which cannot fail to appeal vitally to every Canadian who apprehends its magnitude and has the interests of Canada and the Empire at heart.

Notwithstanding mistakes we have made, or even may make, on such comparatively minor and adjustable issues as tariffs and protection, let us now exercise proper foresight and conserve for our own benefit the electrical energy which can be generated from the Niagara and other powers. There can be nothing equivocal in our attitude; we want no "arrangement" with the United States power interests. To let them build up their industries with power generated in Canada would be a folly compared with which that of parting with one's heritage for a mess of pottage would be wisdom.

A correspondent of this journal who refrains from contributing to the Symposium on Trade Development expresses the opinion, nevertheless, that he anticipates a largely increased trade in woollens, boots and shoes, stoves and a number of hardware specialties.

Cannot Scare Old England—No-One Moves an Eyelid

ONE of the editors of this journal received a letter the other day from our London, Eng., Correspondent, whose jesting allusion to German attacks upon the Old Country is suggestive of the unshaken spirit and confidence of the people in the "tight little island." "What do you think of the latest air raid," he writes. "My daughter was acting at Yarmouth, and although one of the explosions was heard distinctly, and the members of the audience were more or less covered with fine plaster dust from the ceiling of the theatre, there was no panic, and the principal girl, Miss Gay, never faltered in the song she was singing. The show went through to the finish, the only thing being that many service men left the building to go on duty. We expect bombs daily in London, and that's all about it. No one moves an eyelid."

The Engineer and the Empire

IN an address delivered the other day in Montreal, at the Twenty-Ninth Annual Banquet of the Canadian Society of Civil Engineers, the Hon. Sir George E. Foster, Minister of Trade and Commerce, distinguished himself in an able presentment of many matters bound up with the present national situation—matters of vital interest to the engineer as a citizen. The text of the subject was British freedom over German militarism, and the principle was that all bodies of men organized under the British flag should co-operate for the Empire during this crisis.

We were impressed with Sir George's statement that it is a finer thing to be a good citizen than a good engineer, a good doctor, or a good lawyer, and that a man makes a great mistake by fixing himself definitely within the limits of his profession, disassociating himself and differentiating himself from the work of the world. In this day of specialization the engineer is apt to become too specialized in his own pursuits, and, in consequence, to become narrowed down to little more than a blue-print machine.

Public men like Sir George Foster know the worth of civil engineers, but they would appear also to recognize **in** the profession certain shortcomings which are not recognized **by** the profession.

Apart from this suggestion of reflection upon the over-reticence of the engineer,—which, after all, is only our own interpretation—Sir George touched upon a number of topics which are worthy of at least passing mention. From speaking of the engineers who band themselves in societies, and of societies which band themselves with other societies, and of all the various groups of men which form the country and the Empire, the Minister contrived to show for the exclusive benefit of the premier engineering society of the Dominion, how the idea of Empire had come to be a tangible thing, a fixture in the minds of men, an idea which they all loved and gloried in. Then love for it in time of peace, said the Minister, could not be ascertained until peril and danger brought the time of testing.

With one sentiment of Sir George Foster's we are thoroughly in accord, and that is his optimistic suggestion of the gleam of the silver lining which tells of the sun shining behind the cloud. Sir George asserts that despite the present gloom the clouds have broken sufficiently at times to show that the sun is shining behind more strongly than ever.

Such an address, coming from such a man, and presented so ably, reminds us that we are citizens of no mean country—more, it impresses upon us that we are citizens of the one great Empire upon which the sun never sets. The reader will bear these things in mind when he receives this special British Empire Number—an issue devoted mainly to a consideration of the possibilities of Imperial trade development. It is hoped that our readers will vie one with the other in a close perusal of this issue, submitting constructive criticisms of the suggestions advanced.

We may specialize in our little work as engineers, as architects, as contractors, but we cannot specialize to such an extent that we are excused the contribution of our quota to the advancement of that great Empire which is now fighting Canada's battles on the soil of France and Belgium. If we cannot take the sword, we can do our bit in other ways for the advancement of Canada and the Empire.

The Inquiry into the Nickel Question

THE inquiry into the nickel question ordered by the Dominion Government is a step in the right direction, but it still remains to prohibit the exportation of nickel. It is gratifying to learn that the authorities are going to look into the ownership of the mines and ascertain for themselves whether the smelted ore can be refined into the pure metal in this country. But everybody knows what Government commissions are, and we still contend that the first step taken should have been the prohibition of the export of nickel to the United States or any other foreign country.

In the official announcement issued by the Hon. G. Howard Ferguson, Minister of Mines for Ontario, we find the following statement:

> "The nickel industry in Ontario is a very large and important one, expending several millions of dollars in labor and supplies in this province, and up to the present time the Government has not been convinced that any action preventing the export of nickel would not have the effect of transferring the nickel business, or a substantial part thereof, from Ontario to New Caledonia, Norway, or elsewhere.
>
> "Up to the present there does not appear to have been any known process of refining the Sudbury copper-nickel matte that would have permitted of the operation being a commercial and economical success in Ontario.
>
> "Metallurgical science, however, has made rapid advances in recent years, and it may be that the conditions with respect to the nickel industry have materially changed. In order to ascertain all the facts and acquire full knowledge of the situation, it has been decided to appoint a Commission to investigate the whole question. If the report of the Commission makes clear the practicability of refining nickel in Ontario, the necessary steps will be taken to see that this is brought about."

This statement is satisfactory only within certain limitations. As to the practicability of refining nickel in Canada, a leading metallurgist—perhaps the most prominent man in his profession in the country—tells us that there are no technical manufacturing difficulties in the way, and that the only question is whether the enterprise would be a commercial success at first. The main contention is still in the balance, and we subscribe most enthusiastically to the Bill, notice of which has been given to Parliament, seeking the entire and immediate prohibition of the exportation of nickel matte. A careful deliberation of such important questions is in place, but "hope deferred maketh the heart sick" and enough time has been consumed already. Canada must not be a contributing factor toward an article contraband as against the Empire.

The Government exists for the people, not the people for the Government. The Canadian Government's first duty is to Canada and its next to the British Empire. In regard to the course that the Government has pursued, neither of these duties has been discharged. That such an important issue should have been enveloped in secrecy is a reflection upon any government, irrespective of party.

What is the influence that has been brought to bear? We find the Ontario Provincial Secretary, Hon. W. J. Hanna, on the Board of the International Petroleum Company, which is incorporated with the interests of the Imperial Company and controlled by the Standard Oil Company. To what extent, we wonder, are the interests of the Dominion Government bound up with those of the International Nickel Company?

Apart from the unemployment problem in the Sudbury district—which is a comparatively minor and at any rate an adjustable issue—whose interests have we to serve but our own? The raw material is ours to dispose of at will. What does the stranger within our gates care about us? Are we to place him in the scale and weigh him against our responsibility to the Empire?

At Ottawa last week the Premier made public the correspondence regarding measures taken to prevent Canadian nickel from reaching the enemy, but the production of the letters enshrouds in mystery still further the "protective measures" alleged to have been taken. An interesting side-light is the fact that the "protective measures" were arranged by Mr. Graham Bell, Controller of the Department of Railways and Canals, under the Hon. Frank Cochrane. (Mr. Cochrane has extensive interests in the Sudbury district, has he not?) Surely one might have expected more representative and more influential action on the part of the Canadian Government.

We prohibit the exportation of saw logs and pulp wood from Crown lands. What are saw logs and pulp wood compared with nickel matte at such a crisis in the Empire's history?

In a previous article we referred to Canada's responsibility in this matter as measured by the action of Australia and New Zealand, both of which countries prohibited the export of wool immediately upon the outbreak of the war. Wool was only allowed to leave these countries by special license, and then only in the event of its being consigned to the United Kingdom and the allies by ships of British or allied registry. And then later we find the importance of this measure recognized by the British Government, which comes forward and buys the whole wool surplus of Australia, amounting in value to nearly one hundred and twenty-five million dollars.

What excuse can there be for any vacillation in regard to the Canadian export of nickel? It should not rest upon the exponents of a certain phase of politics, nor upon those who do not happen to be identified in any way with the interests of the International Nickel Company, to prove that Canadian nickel has reached, and is reaching, Germany for use in the construction of war machinery. In the time of such a vital trial to the Empire, the mere breath of suspicion should be sufficient. So far, the one-half—and the more important half—of Canada's duty remains undischarged.

By the time the Ontario Government's commission submits its report the war may be over—to the lasting shame of the Dominion.

"The Possibilities of Developing Trade within Canada and the Empire."—A Symposium.

Foreword by Sir George E. Foster, K.C.M.G., M.P.

Minister of Trade and Commerce

Sir. George E. Foster

Editor Contract Record:

I have had the pleasure of looking over some of the Advance Sheets of your Empire Issue in which you collate the views of a large number of practical, professional and business men as to the development and extension of Canadian Empire production chiefly along industrial lines.

The thought that led you to ask for these views was a happy one, and the result will bring into the active area of suggestion a most valuable contribution to incentive and effort.

It is so easy to keep to the well-worn courses, buy and sell where we have been accustomed to buy and sell, and choose what we have been accustomed to choose, that it requires something like the violent and costly dislocation which the war has brought about to shake us out of the ruts. Now by necessity first, and the exercise of common sense next, we are envisaging the possibilities, and to our surprise we are beginning to see endless sources of supply and possibilities of manufacture of which we were before all too oblivious.

Suggestion first, then organization. Such agencies as yours and mine deal largely in the former; the organization must be left to the practical and scientific men, whose joint efforts were never so much needed, and never had a better "Coign of Vantage" for their co-operation than now.

Every dollar saved in the import of raw materials for industrial production decreases or avoids indebtedness abroad, and vivifies natural development at home. Every process successfully initiated and operated here employs and trains hand and brain, and adds to our unit strength, whilst at the same time it saves for disbursement here what otherwise would go to outside countries. And the benefit runs like fresh, vitalized blood through all the veins and arteries of the body of industry, and imparts health and strength.

Nor need we fear that however much we may increase the Made-in-Canada production, we shall not have much to exchange with outside countries, on the contrary, we shall probably have more, for we shall create both the supply for exchange, and the financial ability to purchase abroad.

Adaptation is the mark of resource and alertness, and Canadians are showing these qualities in the way they are taking advantage of opportunity both in the solicitation of unwonted orders, and their quick organization to make and make well what they thus obtain.

To fill the void caused by cessation of supply from long-established sources, by producing the same or equivalents of them is only one step, and the least important To so marshal and organize and perfect, as to be able to hold the business when conditions of competition gradually return to normal is far more essential—not to manufacture merely for the Empire's emergency, but to establish the permanent industry.

May I add two cautions:—

1. The patriotic impulse may help to excuse, for a limited time crudeness of make, and comparative lack of quality, but will not carry further. The wares must be up to the mark and reasonable in price, or the economic impulse will prompt customers to seek what they want where these two qualities are found. Neither the flag nor the hurrah will suffice to excuse lack of good workmanship or extravagance of price.

2. The natural desire to bridge the period of unemployment, and keep the wheels going on unusual army contracts, should not divert the minds and energies of our producers from the necessity of pursuing the staple lines of industry and finding markets at home and abroad for their output. These abnormal needs, we hope, will soon abate, and the wise makers will, from the first, differentiate between the temporary and the usual, and whilst making what they can of abnormal calls, will remember that their business is to cater for the normal and continuing wants of humanity.

George E. Foster

The Possibilities of Developing Trade Within Canada and the Empire

A Symposium

Arranged Alphabetically by Contributors

Consulting Engineer Points to Market for Machinery and Other Products

(Lucius E. Allen, Consulting Engineer, Belleville, Ont.)

There are many latent industries in Canada which simply require the necessary spark, started by the co-operation of Canadian and British ideas, to develop into thriving commercial actualities. From personal observation, the writer was impressed with the fact that while the manufacture of Portland cement was first started in England, the general and varied use of concrete, reinforced concrete, etc., does not seem to be so general in Great Britain as in Canada, and the use of **modern concrete machinery** does not seem to be so extensive. Why not cultivate this extensive market, Mr. Manufacturer?

We could then pass on to the production of a vast number of commercial chemical products, the raw material for which exists in almost inexhaustible quantities in Canada, products which are now manufactured almost exclusively in Germany. Great Britain will require these products, heretofore purchased in Germany, and why should not Canada place herself in a position to supply this market within the Empire? Wood products, such as wood blocks for creosoting, are required, and many other similar lines. Let us not spoil this market by too hasty action, but rather make a personal study of the requirements and conditions, and follow by persistent and consistent effort. The results will be forthcoming.

* * *

The Call of the West

(W. P. Alsip, President Alsip Brick, Tile & Lumber Company, Limited, Winnipeg.)

Winnipeg, located at the junction of the Red and Assiniboine Rivers, is fortunate in being the centre of great deposits of all kinds of constructional material.

The Red River, with its source in Central Minnesota, flows in a northerly direction, forming the boundary line between the State of Minnesota and North Dakota, to the Manitoba line, where it enters a little east of the centre, continuing almost due north to Winnipeg. The Red River Valley has been called "the Bread Basket of the World," and has much the same soil and prairie country until Winnipeg is reached. Here we find a general breaking up of conditions: the soil in the valley is much the same, but the absence of building material, so marked up to this point, is changed. Here we find brick clay, second to none in America. Common brick, drain tile, hollow brick, are manufactured by several firms for the local market. Flower pots and ornamental ware have been produced.

In the south-west part of the city, we have the Canada Cement Company, with its large plant turning out thousands of barrels of Portland cement from clay found on the prairies. To this clay a high-grade calcium lime, shipped in from Lake Manitoba district, is added. There are also two companies manufacturing high-grade white lime from this same limestone—equal in quality to the well-known Kelly Island, shipped in under heavy duty and freight, from Duluth, Minnesota. North, east, and west, ten to twenty miles, are located deposits of the best grades of sand and gravel in quantities to fill all wants for generations. North-east of the city is found the Tyndall lime-stone, of which our new Law Courts and Parliament Buildings are being built. Several large quarries and complete factories have been erected and operated. The products of these factories are shipped to most of the cities of the West. The lime-stone that is found not fit for cut stone or rubble work, is buried and produces a very superior grey lime.

A large factory has been erected at Carman for the manufacture of sewer pipe, drain tile and hollow ware. Several cars of the sewer pipe have been shipped to the city, and with little improvement will be equal to the imported pipe. With the completion of the locks at St. Andrews' Rapids, a large territory, with valuable material and cheap water transportation, has been opened up. At present, crushed granite, sand, lime-stone, cord wood, and lumber are brought up to this market. Two large factories manufacture hard wall plaster and plaster of paris from gypsum mined on or near the shore of Lake Manitoba. In addition to supplying the Winnipeg market, their factories ship to all the territory east of the Rocky Mountains.

High-grade rough texture red faced brick are now being manufactured at Sidney, Man. These brick are filling a long-felt want, as this class of brick heretofore was all imported from the United States.

Added to the above, we have our forests to the north and east, where most of the ties, piles, telegraph poles, fence posts, lumber and feul used are produced with very little expense for freight.

Our water power, second to none on the Continent, enables us to manufacture with the lowest rate for power.

With all kinds of building material close to Winnipeg, and with factories second to none now built and being built, it behoves everybody that material manufactured in Winnipeg, Manitoba, or Canada, is specified and used, giving preference in the order named. If this is done the dollars will be left to circulate at home.

* * *

Imperial Trade for Canada Dependent Upon Special Facilities for Production

(Lieut.-Col. W. P. Anderson, C.M.G., Chief Engineer, Department of Marine and Fisheries, Ottawa.)

The policy of my Department is to employ native materials, and do work in the country as far as possible. This is a sound policy—not only because it develops Canadian trade, but because it keeps the money in Canada. A ship built outside the country may be built more cheaply than at home, but the price of her is lost to the country in the one case, whereas in the other it becomes part of Canada's liquid assets. I am no believer in forcing manufacturers or trade into unnatural channels. Any attempt to do so is predestined to failure. We can only hope for success in developing Imperial trade in Canadian manufactures where we have good facilities in the way of production—cheap raw material, cheap power, cheap labor, or a special market.

* * *

The Manufacturer and "Patriotism"

(John S. Archibald, of Saxe & Archibald, Architects, Montreal, Que.)

There are possibilities of "developing trade within the Empire," but this development must proceed along lines purely of merit, and not under the guise of "patriotism." This word "patriotism" is being misused to-day to cover all the shortcomings of the manufacturing world in Canada. We are being deluged with advertising matter calling upon us to use and specify Canadian-made goods in the name of "patriotism." It appears to me that "patriotism" is to be found entirely on the side of the consumer. The manufacturer spends his time in waving the flag with one hand and boosting prices with the other, and you will usually find that when "patriotism" interferes with profits, he throws the former overboard and hides himself behind the screen of "the necessity of fostering home industries."

The Contract Record writes concerning the "development of the great Empire to which we belong." How many manufacturers in Canada will agree to an increase of the preference to the Mother Country, or indeed to the whole Empire? True, they are quite willing that the preference shall be increased on the other fellow's goods, but on their own—oh no! they are ready to sacrifice their friend; their "patriotism" begins and ends there.

Let the manufacturer turn out goods of such a quality that they will command a market irrespective of flag.

As a result of the high protective policy under which this country is suffering, a large percentage of the manufacturers of Canada are forcing upon the public articles which are inferior to those which can be obtained elsewhere, but at a slight reduction in price, so as to hold the market.

Take the pressed brick industry. Why should we protect this special line? The raw material is at our door, and labor is cheaper than in the United States.

The Canadian manufacturer of boots and shoes, protected by a high tariff, calls upon Canadians to be true patriots, and wear only Canadian-made shoes; yet he finds it more profitable to buy his lasts in the United States.

If the manufacturer honestly desires "to foster trade within the Empire" in order to aid in "the development of the Great Empire to which we belong," let him—

1.—Endeavor to reduce the initial cost of production.
2.—Manufacture an article, not "equal to," but better than those of his competitors.
3.—Capitalize his business on the actual cash invested and prohibit stock watering.
4.—Agitate for free trade within the Empire, with protection against outsiders.

Then may the Canadian manufacturer honestly wave the old flag and take his full share of the credit for that patriotic spirit which is carrying us to victory on the firing line today, but which is entirely absent in the common intercourse of commercial relationship.

* * *

How to Create a Permanent Demand for "Made-in-Canada" Goods

(R. W. Ashcroft, Advertising Manager, Canadian Consolidated Rubber Company, Limited, Montreal.)

It seems to me that the best way to create a **permanent** demand for "Made-in-Canada" goods, is for each manufacturer in the Dominion to **turn out goods of the right quality, at the right price,** and to **let the public know that he is doing so.**

I have given a great deal of thought to the idea of a "Made-in-Canada" trade-mark or "hall-mark" to be applied only to first-quality goods produced by responsible Canadian manufacturers, and I have devised such a mark.

While it would be ideal to have the better-class manufacturers in the country get together and familiarize the public with this mark, I doubt very much the practicability of such a scheme, and I have about come to the conclusion that the best plan to pursue is for each manufacturer to boost the "Made-in-Canada" idea individually and back it up by producing goods which, in quality and price, either compare favorably with, or excel, imported merchandise.

I have discussed this matter with a number of the leading manufacturers of the country. Most of them are in favor of a universal mark as suggested above, but the majority are of opinion that it would be a difficult matter to carry the idea into effect and regulate and control the use of the mark properly.

* * *

Unique Location for Manufacturers—Redcliff, Alta.

(J. E. Askwith, Town Engineer, Redcliff, Alta.)

In considering the opportunities for trade expansion, one is confident that the Dominion will prove to the world at large that up to the present time her tremendous natural resources have scarcely been scratched.

Redcliff is a unique location for manufacturers of the various lines required throughout the Empire. There are good openings here for a tannery, a machine factory, and a tool manufacturing plant. Natural gas as a source of power is available at the low cost of 5c. per 1,000 feet (1100 B.T.H units per cu. ft.). An abundant supply of pure water is obtained from the South Saskatchewan River, which marks the southern boundary of the townsite. A level site, about 230 feet above the river bed, is an advantage, giving no natural difficulties to overcome. Free sites are given for all industries. The low cost of production at Redcliff means a safe margin of profit for the manufacturer over his competitor. Redcliff is situated on the main line of the Canadian Pacific Railway, about midway between Winnipeg and Vancouver.

* * *

Structural Steel Plates and Shapes

(M. Beatty & Sons, Limited, Welland, Ont.)

We are of the opinion that Canada should manufacture her own plates and shapes. As everybody knows, little of this class of material is rolled in Canada. Some of it is purchased in Great Britain and Belgium, but by far the greater proportion of our requirements in the way of structural steel plates and shapes is furnished by the United States.

We have no grudge against the United States—far from it—but primarily our interests must be the welfare of the Dominion, and one would think Canada big enough now to establish these mills here.

We know that the U. S. Steel has this matter in view, but surely some action could be taken which would expedite the matter of giving Canada her share of a most important industry.

* * *

Solid Drawn Steel Water Mains

(S. Barlow Bennett, Municipal Engineer, South Vancouver.)

A feature of vital importance in this western country is to have a good supply of water mains. There is no doubt that one of the best classes of pipe which has been manufactured in this generation is the Mannesman Solid Drawn Steel Pipe. This is really of German origin, although I understand a large amount is being manufactured in Cardiff, England, under a German patent. As all patent rights with Germany are now like the houses of the Belgians, "gone to blazes," it is up to the enterprising Canadian to have this pipe manufactured here in British Columbia.

We have lots of iron, plenty of coal, and efficient labor. This is a means of developing trade not only in British Columbia and the Dominion of Canada, but in the whole Empire.

The question of manufacturing solid drawn steel water mains is one which should have the early and untiring energy of water pipe manufacturers.

More Publicity

(Barott, Blackader & Webster, Architects, Montreal.)

One point that occurs to us is that the people in general are not sufficiently familiar with Canadian-made products. Our goods should be advertised more extensively and systematically. Materials of a special nature, and of purely Canadian production, should be featured more prominently —not only before Canada, but before the commercial world generally.

* * *

A City Engineer Urges the Appointment of a Government Commission

(J. W. B. Blackman, City Engineer, New Westminster, B.C.)

Without question now is Canada's golden opportunity to establish certain permanent industries. In the redistribution of German trade, this war has opened up an opportunity which Canada should seize. I would strongly recommend that the Government appoint a commission to institute immediate enquiries as to what industries are required, where they would be best located, and what would be the probable demand in each case. As capital is going to be difficult to obtain, even for legitimate industries, the report of such a commission would give confidence to investors and assist greatly in this excellent movement.

* * *

Canada's Internal Development in the Production of Raw Materials

(S. P. Brown, Managing Engineer, Mount Royal Tunnel & Terminal Company, Montreal, Que.)

I am much interested in any development work in Canada, as everyone must be who is engaged here in active and creative work.

At present, under our protective tariff, every incentive is given to the manufacturer. This is a great hardship upon the consumer, who has to pay a price sometimes one-third greater than he would pay in the United States, while working for a salary no higher than he would receive on the other side of the line. I think we all realize that our growing industries must be encouraged.

The important item for us to bear in mind is the development of Canada's natural resources, which are rich beyond the dreams of avarice. The time will come when the protective tariffs will be reduced greatly, or eliminated entirely. At that time, unless the raw materials can be secured at their most reasonable cost, the manufacturer who has become accustomed to the protection which removes the necessity for keen competition will find himself in a dire situation. With the present encouragement given to manufacturing—an encouragement which amounts to an invitation to outsiders to establish factories or branches in Canada—too great stress cannot be laid upon the importance of Canada's internal development in the production of raw materials.

* * *

Many Structural Materials

(Burke, Horwood & White, Architects, Toronto.)

Among the most needed materials in building construction in Canada is a light grey stone for the facing or trimming of buildings, which will be at once easily worked and durable:—something to compete with the Ohio or Indiana stone now so much used.

The manufacture of ornamental terra-cotta, equal to the imported article, would be an important addition to our native products. We should think there was now sufficient demand in the Dominion to warrant its manufacture.

We are dependent largely on imported roofing slate, although we are supposed to have a quarry or quarries of good material in Eastern Canada.

We need a greater development of facilities for supplying native marble for the interior finish of lavatories, etc., to compete with Tennessee and Italian marble.

All our glass is imported. It is possible that it would not pay to establish a plant in Canada. There is an enormous quantity used, not only of sheet, but of polished plate.

We are dependent on imported material for all the larger sections of beams, angles, etc., required for structural purposes. There is a great demand for this material.

We are dependent on imported material for our floor tiles, tiles for facing walls of lavatories, etc., for which the demand is large. We are also dependent on imported face brick of a shade to harmonize with grey terra-cotta. The face bricks now made, while excellent in quality, are too buff or yellow in shade for the purpose required.

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Rich Deposits of Marble, and Other Opportunities

(J. B. Carswell, Architect, with Messrs. Ross & Macdonald, Toronto.)

This symposium provided a welcome opportunity for architects to express their views on this great "Made-in-Canada" campaign which has been launched throughout the Dominion. There is a very grave danger, in our enthusiasm, of carrying this campaign far beyond the limits of its practicability. The subject suggests a much better title, "Made in the Empire," for we must remember that Canada in its present stage of development cannot supply all her own wants, nor will she be able to do so for many years to come.

I have no doubt that the present effort was well timed, in fact it was greatly needed, but let us beware of causing premature births of, and unnatural forced growth in industrial activity, which would most assuredly be disastrous in the long run.

There is a further danger in this campaign. A striking example of this second danger is the present hardware situation. As most people know, there is a heavy protective duty on imported hardware. Article for article, the Canadian manufacturer has not quite reached the excellent standard set by the United States manufacturers, but when we go to purchase we find the prices, "ceteris paribus" are almost identical; furthermore, we find the Canadian hardware man in the front rank of this campaign, appealing to our patriotism, turning out an inferior article, and pocketing the government's tariff.

In regard to specific cases where trade could be developed within the Empire, one very striking example is to be found in the marble business. Only about one hundred miles north from us here there lie square miles of country containing some of the richest beds of marble in existence. Specimens taken from these beds show a magnificent variety of texture and color, and yet we architects must still look to Italy and the States for this material. Here is an instance where Canada should be supplying not only herself, but the United States and the Mother Country as well.

The same remarks, although in a modified form, might be applied to limestone, which is imported from the United States in such quantities. The "deserted villages" up in the Credit Valley district might be thriving little towns if the monied interests in this district would only have the courage to step in and operate the great fields of stone which lie there dormant. The Credit Valley stone is more durable and the color more varied and interesting than any of the American limestones, but these peaceful valleys are still waiting to hear the tune of a modern rock drill.

In conclusion, let me cite two cases where the Canadian Government through its surveyors or geologists could greatly benefit us all. They could locate a slate bed to take the place of the great slate quarries in Bangor, Pa., and a suitable clay from which glazed terra-cotta could be manufactured. At present practically the whole terra-cotta industry is in the hands of a few American manufacturers. The English firms have lost the business partly through shipping difficulties, but partly also through that lamentable indifference to Colonial trade which is to be found in so many English firms operating on this side.

Iron and Steel Manufactures, and the Glass Trade

(W. H. Carter, President, Carter-Halls-Aldinger Company, Winnipeg.)

The possibilities for trade development within the Empire are not essentially different from those that existed before the opening of the European war. In fact, it is recognized everywhere that these possibilities have only been accentuated by the new and changed conditions. To what extent these new conditions must affect the building trades sooner or later need not be left entirely to conjecture.

It should be recognized at the outset that in the building trades three parties, at least, are most immediately concerned with this question, namely, the contractor, the architect and the manufacturer of structural materials. The motives that will compel the attention of these three parties to the general trade situation may be self-interest or patriotism, or both; yet in any case a careful analysis of the present situation will bring overwhelming conviction of the unusual possibilities for profit, provided the present problem is faced with a reasonable degree of judgment and discretion.

In what way can the contractor best give encouragement and assistance to the trade situation within the Empire? Surely not by an attitude of selfishness and indifference in his business dealings with the architect and the structural manufacturer, but rather by seeking, more persistently than at any previous time, to discover every possible meeting point for co-operation and helpfulness in his relations with the other parties to the contract. This will mean careful study with a view to ascertaining exact costs of raw materials, manufacture, transportation and labor; but more especially it will mean an aggressive campaign looking to the systematic encouragement of the architect and the structural manufacturer along the lines of home production.

Next, the architect: his is the task of specifying as to the particular items of structural material that are to enter into the finished product. A year or so ago little or no question was raised whether glass from Austria, electrical fixtures from Germany, or steam boilers from the United States were specified. At that time it was chiefly a matter of salesmanship on the part of the foreign manufacturers; and architects as a class were not particularly concerned, so long as the material supplied met every needed requirement of the building in question. To-day, however, all this is changed, and no effort should be spared to impress upon the architect his opportunity as well as his patriotic duty of specifying "Made-in-the-Empire" materials in every possible instance.

Finally, all such efforts on the part of the contractor and the architect must count for little or nothing unless the structural manufacturer prepare to meet the requirements of the new situation. The iron and steel trade may be cited as an example of to-day's conditions. In British trade reports it is shown that in normal times three million British workmen depend upon the building trades, in which both iron and steel materials are among the chief materials employed. With the Continental supplies of pig iron and raw material largely cut off, British manufacturers must look principally to Canada and the United States for these materials. What a mistake if Canadian producers neglect to prepare themselves for meeting the new demands which must presently arise! What a misfortune should the score or more of Canadian manufacturers of black and galvanized iron, structural iron, iron sheets and iron scrap suddenly discover this immense business going to their competitors, simply on account of their own failure to foresee the demand and equip their plants to meet it!

A similar opportunity exists in the glass industry. Glass imports from Belgium into Canada have amounted to nearly $500,000 in one year, these figures including window glass and glass fixtures. There are nine glass and glassware manufactories in Canada, and yet geological experts state that we have here no lack of sand deposits of the quality best adapted for high-grade glass manufacture. Presently, and in the near future indeed, this structural product must be increased in demand, and Canadian glass manufacturers will undoubtedly wake up to find themselves fairly swamped with orders. Are they preparing to meet the new situation? Are their plants and equipment in readiness? The opportunity is clear and unmistakeable, but the time for preparation is to-day, not to-morrow.

These are merely suggestions of the extraordinary trade possibilities now opening up within the spacious limits of the Empire. The close of the war, whether it be sooner or later, will see these possibilities tremendously enlarged and expanded.

As viewed from the contractor's standpoint, the present situation is full of promise.

* * *

By-Products of Coke Manufacture

(C. C. Clark, A.M.I.E.E., Electrical Engineer, Toronto.)

We are all familiar with the cry for "Made-in-Canada" goods; indeed many of us have purchased inferior goods at higher prices, with the idea of being patriotic. This policy, to say the least, is a narrow-minded one, not in keeping with the ideas of the Canadian people as a whole, but probably engineered by a few manufacturers for their own benefit at the expense of the consumer.

There have been statements in the papers that Canada should try to capture the world's market. In order to accomplish this, Canadian goods would have to be better in quality and lower in price than those of our competitors. Just as long as Canadian people buy inferior articles at fancy prices because they are made at home, and thus discourage legitimate competition from the remainder of the Empire, so long will the quality of goods manufactured in Canada improve very slowly. Competition is absolutely necessary if we are to have healthy trade, and it is indeed good news to find the high-class publications behind a "Made-in-the-British-Empire" campaign.

In regard to additional manufacturing opportunities, I would point out that in the West, especially, there is an enormous waste of valuable coal by-products in the manufacture of coke. When coke is manufactured in beehive ovens, coal gas, ammonia and tar are allowed to escape into the atmosphere. From the tar a great number of valuable by-products can be distilled. These by-products include carbolic acid, pitch, creosote, light oils, and even aniline dyes, which heretofore have been imported almost exclusively from Germany. Also phenol, used in the manufacture of picric acid, for explosives, is a by-product of coal tar

With regard to the ammonia, this can be recovered in the form of sulphate of ammonia, which is extremely necessary as a fertilizer for land in the Canadian Northwest on account of the high percentage of nitrogen which it contains.

Surely, therefore, instead of allowing these valuable products to go to waste, an effort should be made at conservation. This is one of the many cases where natural resources are being wasted through want of efficiency in their development. It is pleasing to note, however, that the Government is taking all possible steps to remedy such wastes through its Commission of Conservation.

* * *

Structural Steel

(A. W. Connor, Consulting Engineer, Toronto.)

Few people appear to realize that with the great industrial advances made in Canada in recent years, and in spite of a greatly increased demand for steel for structural purposes, there is as yet practically none rolled in Canada. During the writer's connection with the steel industry, Canadian mills have developed from producing nothing to a very considerable output in steel rails, light angles and bars for reinforced concrete, architectural and many other uses. Practically all our structural shapes, however, are imported from the United States, Germany, Belgium and Great Britain. Apart from bars, I venture the opinion that not one pound of Canadian rolled steel is contained in the structural frame of any of our skyscrapers or steel bridges; further, that no bridge company has any such steel in stock. The new Canadian plant of the United States Steel Corporation does not, I believe, contemplate rolling structural shapes.

Realizing how fundamental the steel industry is to most others, NOW would appear to be an auspicious time to take a step forward, with the expected advance of "trade within the Empire" after the war. With German trade fortunately eliminated, with Belgium and Luxemburg unfortunately crippled, and with a good protective tariff, there should be no risk in enlarging our plants so as to be able to supply the increasing demand for all grades of "Made-in-Canada Steel."

My attention has been called to the fact that copper tubing can be imported from the United States more cheaply than it can be bought here, although the copper all comes from Canada. Are our manufacturers asking excessive profits?

* * *

An English Firm Optimistic

(T. Cooke & Sons, Limited, Engineers and Scientific Instrument Makers, London, Eng.)

For the last few years we have contributed a large number of theodolites, levels and such other instruments as are in regular demand among Canadian engineers, but since the outbreak of the war our factory has been practically closed to such manufactures. We are now devoting our attention almost exclusively to the construction of rangefinders, heliographs, gun-sights, clinometers, and such other munitions of war as may help us in the present emergency. It is impossible to say when we shall be able to return to the lines of business in which the Contract Record & Engineering Review is more directly interested, but when that time arrives we shall re-enter the field under more favorable conditions than those we experienced a few years ago, when our name was practically unknown in the Dominion. We look for greatly increased trade with Canada when the war is over.

* * *

Freer Exchange of Information Between Canadian Manufacturers

(W. M. Currie, Vice-President and General Manager, Burlington Steel Company, Limited, Hamilton, Ont.)

I feel that the most effective method of developing our trade, more particularly in Canada, is for Canada to make every effort to deal with Canadians. Frequently we have found that while we are capable of manufacturing certain lines of material, and willing to manufacture them, a great many manufacturers, on account of their old connection, would rather deal with some foreign house. I would suggest that purchasers of manufacturing material having an order to place endeavor first to find out if there is not somebody in Canada who can meet their requirements. If they succeed in getting in touch with some firm who can do so, their next duty is to give that concern as much possible information concerning the quantities required, the prices to be met, and so on. Not only will this promote trade within the country, but it will give the purchaser a market close at hand from which he can always draw. If there were a freer exchange of information between manufacturers, we could develop much business between ourselves—business which would redound to the advantage of both Canada and the Empire.

Study the People, Protect the Water and Food Supplies

(E. Drinkwater, Town Engineer, St. Lambert, Que.)

To develop the portion of the Empire which we occupy —and it is no small part—it is of vital importance for us to make the most of our opportunities. With this in mind the first essential is Population.

I am of the opinion that we need two forms of federal legislature. The most vital legislation required is such that will protect the health of the people, particularly in the more densely-populated areas. Every individual has a considerable commercial value to the community at large, and I think that drastic federal legislation should be enacted so as to protect the water and food supplies, and to ensure proper sanitary conditions among all classes of the people. In this manner a large number of lives may be saved, and the saving would offset to some extent the decrease in immigration which will follow as a natural result of the war.

There should be federal legislation to prevent the waste of all fertilizing matter now destroyed by municipalities, transportation companies and abattoirs, or dumped to the detriment of the health of the community residing in the district. I would suggest that the railways be subsidized for the transportation of such material to agricultural districts. This would increase the productiveness of the land without impoverishing it.

The first class of legislation would increase the population both in number and efficiency, without capital expenditure. The second would increase the productiveness without impoverishing our natural resources, as a result of which more capital would be available for the development of our mineral deposits and agricultural products.

Such development is essential to the independence of that great empire to which it is our privilege to belong.

* * *

Quality and Price Must Be Harmonized

(G. Graham Drinkwater, Vice-President, The Canadian Fairbanks-Morse Company, Limited.)

The average purchaser will always buy in the cheapest market, providing the articles are satisfactory. There is no getting over this fact: it is human nature. Therefore, while the strong feeling of loyalty which prevails just now is valuable because it awakens in British people the world over a keen desire to trade among themselves, this trade must be built up with two things always in mind—quality and price.

This harmonizing of quality and price is no easy matter in a country where the demand is necessarily limited. However, there are possibilities of export trade now receiving serious consideration. These possibilities, if realized, will help to produce that volume of trade in any one article which is so vitally necessary to cheap production.

Ten years ago the particular business in which I am interested imported about 90 per cent. of its goods; today about 80 per cent. is made either in our own Canadian factories or in other Canadian factories. That this remarkable change in the character of a business is not due entirely to sentiment must be very apparent. Only a sound constructive policy will build up a trade which is to live.

Let this splendid spirit of Empire stir us to action, and let us build with the idea that one day we will compete against the world!

* * *

Revision of Tariffs

(Geo. E. Drummond, of Drummond, McCall & Company, Limited, Montreal.)

Unquestionably a legitimate and most considerable trade expansion can be secured in many lines of business within the borders of the Dominion, and throughout the Empire, but it cannot readily and safely be accomplished without first securing a sane and scientific adjustment of Customs tariffs to meet effectively the competition of foreign countries.

Primarily, we must devote our attention to securing a tariff for self-preservation, and the full and proper development of our trade within the home market, and, secondly, to conserve and extend our inter-Imperial trade.

Our own Customs tariff is still "a thing of shreds and patches," and badly requires revision. Then the Mother Land must bring her trade policy into line with that of the self-governing dominions, if we are to arrive at a workable arrangement for the up-building of inter-Imperial trade.

For years I, like many others, have worked, in season and out of season, to further the policy of preferential trade within the British Empire, the prime object being to reach as speedily as possible the time when, by the efficient utilization of our varied and vast resources, in all parts of the Empire, the British family can be made independent of foreign nations in respect to the material demands of life and civilization. To any thinking man the present European war, with all its paralyzing effects, provides ample justification for the propaganda of preferential trade, to which the late lamented Right Hon. Joseph Chamberlain gave so much of his strength and splendid ability in the declining years of his illustrious life. The work of this great Imperial statesman will live, and in the end it will triumph. To secure practical results we must, in many lines of manufacture, face tariff revisions in Canada and elsewhere in the Empire, and the motherland must, as I have already stated, adjust her trade policy to meet the situation. Products which in the past the United Kingdom has imported from Germany and other foreign countries can, under a sane and statesmanlike policy, be supplied by the overseas dominions and colonies, and vice-versa. Much that we in Canada, for instance, buy from foreign manufacturers can be "switched" over to our own kith and kin within the bounds of Empire.

In my own business, that of iron and steel, there are great possibilities for extension into new lines of the more highly finished goods, which until now have been imported principally from the United States and Germany. Such a change would serve to keep our gold circulating within the borders of the Dominion, instead of being sent out to enrich our friendly or unfriendly trade rivals. To accomplish this, however, our Government must undo past serious mistakes of shortsighted "statesmanship" and establish a tariff for self-preservation, one suitable to the times and that will serve to encourage the legitimate development of our material resources. This is the only possible policy for us if we are to lessen our imports and establish something like an equilibrium in our international trade balances.

* * *

More Detailed Information from the British Manufacturer

(By R. P. Durham, Vice-President, John S. Metcalf Company, Limited, Montreal, Que.)

The suggestion that occurs to us as one most likely to increase the use of British goods within the Empire, is that the British manufacturer should issue catalogues giving more complete information. As a case in point, we have in mind the catalogues of manufacturers of grain elevating, conveying and power transmission machinery. On this side of the water, catalogues give, very freely, dimensions and full information regarding the various items of manufacture; in Great Britain such catalogues generally give pictures and brief descriptions, but no dimensions. Naturally it is more satisfactory to an engineer in our line to make use of a catalogue which gives him the information necessary in designing his building, rather than a catalogue which is indefinite. The British manufacturer seems to fear that the information he gives will be used and that he will not profit. This is bound to occur in many cases, but in the long run the complete catalogue will bring the business, and certainly British manufacturers desiring to do business in Canada should describe in detail what they have to sell if they are to compete with Canadian goods already familiar to the designer.

* * *

Methods of Reproducing Drawings

(V. J. Elmont, Consulting Engineer, Montreal.)

The method of reproducing tracings in Canada—at least in that part of the country with which I am acquainted—is so inferior to that employed in Great Britain that there would seem to be a possibility of rendering great service to Canadian engineers and architects, besides establishing a profitable business, by our adopting the various methods of printing employed in England.

Usually our blue prints are by no means good, and the same is true, only in a greater degree, in the case of black prints. The process employed seems to be somewhat antediluvian.

Better classes of black prints—prints which it is almost impossible to distinguish from the original drawing—can be obtained in Europe for the same price as blue prints when three or four copies are taken, and even more cheaply when more copies are required. These are done on paper, linen, or tracing linen. Black prints, with various systems of pipe lines printed in different colors, may be obtained.

A study of these improved methods, as practised in the Old Country, would doubtless bring about marked improvement, and the change would be appreciated by members of both the engineering and the architectural professions.

* * *

A Market for Fine Tools

(J. W. Evans, City Engineer, Belleville, Ont.)

There is a very large market for fine tools in Canada—small files, dental tools, watchmakers' tools, and small tools for carpenters, joiners, cabinet-makers, etc., a large proportion of which are at present imported from Switzerland, Germany and Belgium.

There is every opportunity in Canada for the manufacture of such tools, and many other articles.

We have cheap power, reasonably cheap labor, cheap factory sites, low taxation, and fine schools for the laborers' children.

Manufacturers make a mistake in locating in the large cities. There are a great many small towns and cities in Canada where the laborer can get good comfortable homes at reasonable rents, where there is an abundant amount of fresh air, where the best of schools are within easy reach, and where one can build his home on the instalment plan, and live much more cheaply. From the manufacturer's standpoint, power can be obtained at a lower rate than in many of the large cities, and the best of shipping facilities are afforded both by rail and water.

The present war has pointed the way for this new development, and we should take advantage of it now. Do not wait until someone else leads the way and gets all the business. Let us take up this matter seriously.

* * *

An Opportunity for British Instrument Manufacturers

(Foster Instrument Company, Letchworth, Eng.)

Evidence of the possibilities of "developing trade" is found in the fact that we are able to report increased business in all departments in 1914. The volume of business has been noticeably greater since the outbreak of the war.—this being attributable to the following causes: (1) that additional supplies are required by Government departments; (2) that more instruments are employed by contractors for the Government; (3) that a greater demand has arisen owing to the cutting off of German manufactures in this line. Just before the war we moved into new and larger premises, and so we have been able to take effective advantage of this business expansion. Several of our men have joined various branches of His Majesty's forces, but we are carrying on business with good men who are not eligible for service. In general, we feel that British instrument manufacturers have an opportunity to strengthen their position in the home and export markets. This must be done in such a way as to enable us to retain the advantage in later years when the German manufacturer again becomes a factor.

* * *

Canada Equal to the Opportunity

(Walter J. Francis, Consulting Engineer, Montreal.)

Canada, as a child of the family, has grown and lived happily, free from outside cares. Even the military work, the only element in which warfare is directly reflected, was not taken seriously. All this bears a striking analogy to the happy days of childhood. Now the opportunity for taking a place of responsibility and assistance in the great British family has arrived, and the child is asserting his manhood. It might be said that one of the most prominent evidences of strength is the number of valiant Canadians who have joined the colours. All respect and good wishes for those who have gone or will go. But many must stay behind, and by these great assistance is being and will be rendered. While our old lines of trade have been broken, much new work has come. I am informed that war contracts to the extent of two hundred million dollars have come to Canada since hostilities began. The manner in which one hundred and fifty of our manufacturing shops have taken up the manufacture of shells in the past few months is little short of marvellous. The ingenuity displayed in adapting railway shops, bridge shops and machine shops to shell-making, shows more clearly than almost anything else could have done, the ability of Canadian engineers to rise to opportunities. I am not at liberty to discuss some of the details, and I shall only say that manufacturing operations are now being performed in Canada which are not being done anywhere else in America. And I am informed that more opportunities are coming. Canadian materials and Canadian brains are measuring up to the mark. We are only commencing to realize the extent of our resources in men, in minerals, in forests and in water powers, and it is too early to even suggest the lines of Canadian development during the next two years. As an agricultural country Canada's reputation will increase, and as a manufacturing country her name will be made.

* * *

Paving Blocks

(G. A. German, Managing Director, Sun Brick Company, Limited, Toronto.)

The possibilities of developing trade within the Empire, particularly in regard to clay products, are tremendous. In the farming community there is a large field which is practically untouched, but the field that appeals to me most strongly is the manufacture of paving block. I am sure that Canada can turn out as good a paving block as any that is now being imported.

If everybody would endeavor to buy goods made in Canada, it certainly would assist the Empire movement.

Wood Block Flooring of Douglas Fir from British Columbia

(W. C. F. Gillam, M.S.A., Lic. R.I.B.A., of Bryan & Gillam, Architects, Vancouver.)

The universal cry, "Support Home Industries," is but the "inner wheel" to the larger ideal of developing trade within the Empire, but the architect in British Columbia (and doubtless elsewhere in the Dominion) attempts to confine his specification to local products. He is continually faced (in a great many cases) with the difficulty of obtaining the best in material or manufacture out of the world-wide field for selection.

In the writer's opinion, the "war cry" should be "Wake Up Manufacturers of Canada!" This applies particularly to the manufacturers of British Columbia. If the goods are produced that are demanded, the architects will specify them.

The question naturally arises as to what product Canada, as a whole, can produce that she is not producing now.

Take British Columbia as a lumber-producing province. Does it supply the wood-block flooring that is used so largely in the Old Country? If not, why not? Cannot British Columbia supply as good a wood block as Sweden, Norway or Russia? The writer has found from actual experience that it can. Douglas fir blocks are admirably adapted for the floors of public buildings, schools, etc., where a floor of good appearance, non-resonant, sanitary, and quiet to walk upon is so desirable. The new Normal School Building, at Victoria, for the Provincial Government of British Columbia, is an example. Here wood-block flooring of Douglas fir, grown and manufactured in British Columbia, is used throughout.

"Wake up you manufacturers of Canada, lest others reap while you sleep!"

* * *

The Right Goods and the Right Selling Campaign Required

(Peter Gillespie, Associate Professor of Applied Mechanics in the University of Toronto.)

Trade, nowadays, pays little attention to the flag. "The man with the right goods, at the right place, and with the right selling campaign gets the orders."

Of Canada's aggregate trade for the last fiscal year, 55 per cent. was with the United States, 35 per cent. with the British Empire and 31 per cent. with the United Kingdom. This, moreover, in the face of preferential tariffs. If, in the past, we have bought German clocks, or United States cottons, or French perfumery, or Belgian glassware, when similar lines were available within the Empire, it was not because we are disloyal to that Empire, but because the quality and the price and the manufacturer's desire to adapt himself to the customers' tastes have made the foreign purchases somewhat more attractive. In ordinary times there is little sentiment in trade.

"Our goods are made in these colors and these lengths, and those who are not pleased can go elsewhere." This, according to W. Harbutt Dawson, in "The Evolution of Modern Germany," was the reply given by a leading firm in a great English textile industry to a prospective purchaser who desired some modifications from prevailing styles. In due time the purchasers went elsewhere and now the problem facing this firm and others in like predicament is how to get those rebellious buyers back.

If a change of policy with regard to Canada's trade is to be brought about, it must come chiefly through the activities of the producer. His plant and his methods must be modern, he must attain excellence in his product, and he must advertise his wares. But if tradition and geography and environment are all arrayed against him, as they will be undoubtedly in certain lines, will he not be well advised if he leave to those countries more favorably situated than he, the task of supplying the world's demand in those lines? Notwithstanding this, there is in Canada an attractive field open to Canadian industry for the manufacturer with enterprise, having "the right goods and the right selling campaign."

A Leicester (Eng.) Firm Reports Over-Seas Trade Increasing by Leaps and Bounds

(Messrs. Goodwin, Barsby & Company, Engineers and Iron-Founders, Leicester, Eng.)

It may be of interest to state that our over-seas trade has increased, and is still increasing, by leaps and bounds. Hitherto we have not managed to secure as much Canadian business as we should have liked, but we are optimistic in view of the fact that the other colonies are providing a good market for our machines. We look for improvement in your country and we hope that eventually we shall secure a large share of Canadian business.

* * *

A Permanent Industrial Commission

(A. K. Grimmer, City Engineer, Medicine Hat, Alta.)

The general industrial welfare of Canada has been lost sight of in our personal endeavors for individual locations. At the present time it must be realized that the manufactures which start with nature's products and produce by combinations the completed articles essential to a nation are those which should be fostered and developed. At the same time, these industrials must be protected so that the investor will obtain dividends in times of peace in competition with other countries, though such protection must not be such as will unreasonably affect the consumer.

Each locality should at this time study its own natural resources and their possibility of development—or rather the stage of manufacture to which it can successfully compete with other centres. This in Western cities is often regulated by transportation problems.

I believe that a competent industrial commission could do a great deal of splendid work. Individuals in any locality are often carried away with the ideas of a promoter, and much capital has been wasted all over Canada in the promotion of schemes which, through no other reason than the fact that there was not sufficient market available, have proved failures.

A large industrial movement originated in Medicine Hat some four years ago, and great progress was made in establishing industries many of which are on a sound financial basis, even today. There were others, however, which (although the raw product and cheap power were available) have been unable to make a financial success of their proposition owing to the fact that there was not the market available for the sale of their product in the territory.

It would seem, therefore, that if Canada had a permanent industrial commission to whom investors could refer for advice in investing their money, more confidence would be instilled into the public and a large development of the natural resources of Canada would result. This commission would further study local conditions, their resources and market, and point out to the community the possibility of the development of suitable projects. Further, from their studies they would be able to advise the Government independently in respect to the protection that manufacturers should have from foreign competitors.

* * *

Cultivate the Land and Develop the Water Powers

(Henry Holgate, Consulting Engineer, Montreal.)

In my opinion the starting point should be to strengthen our own position first.

The large preponderance of urban population over the population engaged in agriculture is not a healthy condition. Canada is, and always must be, an agricultural country. This fact, to a large extent, has been lost sight of.

It will be a serious matter if the next census does not show the present conditions reversed. The Governments and the Universities should assist in bringing about this natural condition, the one by facilitating the taking up of land and cultivating it, and the other by encouraging young men to take up agriculture in a scientific way.

As to further development, I would call attention to the immense possibilities in Canada for extending electro-chemical industries, owing to the very large amount of available water power capable of economical development—especially in Eastern Canada. Many details might be touched upon, but these two items impress me as being very important.

* * *

"Made in Canada" First, "Made in the British Empire" Next

(By A. Hutchison, Chief Engineer, Messrs. Drummond McCall & Company, Limited, Montreal.)

The development of Imperial trade, in times like the present, should be an aim dear to the hearts of all Canadians, as it can be productive of nothing but good, while at the same time it will strengthen the tie that binds us all together into one great Empire.

The trade returns between Canada and Great Britain, while they have been improving during the last few years, are not at all what they should be. The fault, such as it is, lies on both sides, but recent attempts to improve the position of the British manufacturer in Canada have been in the right direction. The great difficulty has been to overcome the conservatism of Old Country practice and bring it in line with the ideas of the Canadian buyer. Unfortunately, our ideas are based very closely on those of our friends to the south; however, the British manufacturer is nothing if not enterprising, so that if he is willing and able to re-arrange his methods to meet our ideas it rests with us to co-operate with him to the best of our ability.

There is no doubt that the proximity of the United States has a great influence on this market. The ease of transportation is very much in their favor, with the result that deliveries of goods are obtained more readily than from Great Britain. This is one of the main points at issue. The Old Country manufacturer cannot understand why his American competitor can turn out work so quickly. The principal reason seems to be that the American specializes more than the Britisher, so that his shops are laid out for more rapid despatch of work. The difference, however, is not very great, and it is one which can easily be overcome if the Canadian buyer will anticipate his requirements a week or two. Against the British manufacturer there is always the ocean transportation, which entails innumerable handlings and liabilities to damage. Every effort is being made to guard against damage, and the results are becoming more gratifying every year.

Old Country manufacturers are now beginning to appreciate the value of this market, and great thanks are due to the indefatigable efforts of our Trade Commissioner, who is thoroughly alive to the situation and whose work is meeting with the success it deserves.

The successful launching of British goods into Canada requires, above all else, the services of competent men to direct prospective buyers. There are innumerable articles which could be put on the Canadian market to advantage and the opportunity is always at hand for the enterprising individual to achieve success. Unfortunately, a great deal of trouble has been caused by an unwise choice of agents on the part of the British manufacturer, with the result that the Canadian market has lost its charm in cases. The representative in Canada should have at his fingers' ends all the details of the goods he is selling, so as to be in a position to answer any query put to him by a prospective buyer. There is nothing which annoys a buyer more than the inability of a salesman to furnish essential information, and very often the man on the spot with a knowledge of the situation has a great influence on the swinging of an order.

Nowadays, we hear quite frequently the slogan, "Made in Canada," and much there is to commend it; still, it is well not to allow oneself to imagine for a moment that everything that Canada requires for her growing needs can be made in this country. Even the oldest countries are unable to produce all that they require, and they have to import a great variety of articles for their miscellaneous needs. Much more so is this the case in Canada. A young country, such as this, without the vast experience of the Old Country, cannot expect to be in a position to branch out into the development of all kinds of articles which require so many years of close study and research to achieve that perfection which is the assured quality of British material.

The purchase of Canadian-made goods has much to commend it, as it helps to build up industries necessary to the development of the country, but it would certainly be a mistake to give the Canadian manufacturer a prohibitive tariff, as industry would then be growing up along the lines of false economy. Wholesome competition is what is required, as in this way the Canadian manufacturer will be trained to take his proper part in that world-wide trade which should be his aim in the near future.

By all means let us one and all help along the Canadian manufacturer, so that he can have a reasonable profit on his goods, but do not let us arrange matters so that no one else need apply. As far as possible, the aim of the Canadian buyer should follow the lines laid down by Hon. Sir Geo. E. Foster in his recent speech in Toronto. Sir George says that when he wants to buy anything he will see that he gets the Canadian article, if it can be obtained at a reasonable figure; otherwise he will buy what is made in the British Empire.

Give the British manufacturer his due! If it is a question between American or British goods, let the casting vote be in favor of the latter, as in this way the bond of union will be really strengthened and we can say with a surety, "Trade Follows the Flag."

* * *

Calcined Magnesite and Chloride of Magnesia

(Interior Construction Company, Limited, Winnipeg.)

We use several car-loads of calcined magnesite and chloride of magnesia during the year and from ten to twenty car-loads are used in the city of Winnipeg. We believe that there is a good opportunity for a firm to manufacture this product in Canada, as magnesite is found in its natural form in Quebec. It may be of interest to report an investigation made by the Canadian Salt Company, of Windsor, Ont., made with a view to ascertaining the quantity of chloride of magnesia shipped into New York last fall. This disclosed that in August about 338,000 lbs. were imported into New York; very little arrived in September and only a few drums in October, but during the first two weeks of November over 800,000 lbs. were imported into New York from Rotterdam.

* * *

"Vast Possibilities of Trade with Other Parts of the Empire"

(Iona Gypsum Company, Limited, Sydney, N.S.)

This company has full faith in the future of the Canadian market for gypsum products. We have faith, because we know that there is room in Canada for Canadian-made goods; consequently our efforts have been directed towards development in this field. Whilst so doing, however, we have become convinced of the vast possibilities of trade with other parts of the Empire. From actual results obtained, our convictions are confirmed, and, we feel that the time is opportune for Canadian manufacturers to broaden their vision and prepare not only to supply the requirements of our own vast and growing Dominion, but also to provide the requirements of our sister states within the Empire, thereby deveolping an export trade which will mean millions of dollars annually to this country, and promote a unity of purpose and of effort, making for a stronger tie of interests, both commercial and national.

* * *

Opportunities in the Clayworking Industries

(Joseph Keele, Department of Mines, Ottawa.)

The clayworking industry of Canada operates within a rather limited range of products, it being restricted for the present chiefly to the manufacture of building brick of various kinds; hence there is a heavy annual importation of clay wares. The reasons for this are: (1) it is only of recent years that this country has afforded any considerable market for clay wares; (2) the native industry is not equipped technically to meet the demand; (3) there is an absence of clay suitable for the manufacture of high-grade wares, such as table ware.

The manufacturers of the rougher grades of clay products now have an opportunity to extend their plants to include any of the following wares which are not at present produced in Canada: paving blocks; electrical conduits; roofing tile and floor quarries; insulating brick for furnace construction; and unglazed architectural terra-cotta. There may be a sufficient demand for some of these lines to keep a plant of fairly large capacity running.

The importation of high-grade clays, for mixing with the low-grade native clays, which is necessary for the production of certain kinds of ware, is a further suggestion. This would ensure that the wages paid for labor were kept at home.

The clayworker can help the farmer by supplying him with better tile and plenty of it, for the purpose of underdraining. This operation greatly increases the production of land, which is a very desirable object at any time, but especially so at present.

* * *

The Voice of Kamloops

(E. G. Kingwell, City Engineer, Kamloops, B.C.)

Geographically, Kamloops occupies the same position to Canada that Spokane does to the United States. As the capital of a great interior Inland Empire, Kamloops should not be overlooked in a consideration of trade opportunities. Mining interests hold out great attraction, for it is difficult to find any other district comparable with this in regard to the large and varied classes of ore that are to be found in paying quantities. Coal, copper, iron, gold, mica, cinnabar, silver and lead are all awaiting to be worked.

The boundless forests here suggest great possibilities for the pulp manufacturer, the furniture maker, the sash and door industries and fruit box manufacturers. Tanners, leather manufacturers, woollen merchants, glove makers and others should be able to open up a large and profitable market in this district. It may be taken as a conservative estimate that from this immediate neighborhood six thousand to eight thousand hides are exported annually, and with the areas opened up by transcontinentals and waterways, this total could be augmented considerably.

The way in which small fruit farming has gone ahead suggests that a canning plant could be operated profitably, and there are openings here for flour mills, lime and cement plants, potteries and paper mills, while there is every inducement to be found for interests representing agricultural implements, mining machinery, irrigation and pumping machinery, and well-drilling apparatus, also for wholesale and distributing houses of all kinds.

The city is peopled by 5,500 inhabitants. It covers an area of 922 acres, and it is well lighted, well paved, and possessed of excellent railway facilities. Climatically, Kamloops is the envy of British Columbia.

More Detailed Information as to Imports

(R. R. Knight, City Engineer, Fort William, Ont.)

With her vast natural resources and immense possibilities in the way of power development, Canada has unequalled opportunities of industrial development. She is within easy access of the European market—a most important factor.

The proper publication of imports to the Empire, giving helpful details as well as statistics, would tend to open the eyes of capitalists to the opportunities that exist in the way of establishing new industries in this country. I would advocate the publication of Bulletins on Production by a Government department. Such a department, assisted by a board of competent advisers, could do excellent work in furnishing information to industrial applicants.

My suggestion is partly met by the Weekly Reports of the Department of Trade and Commerce, but what I have in mind is the furnishing of information concerning imports to all British possessions from foreign countries, so that Canada could look them over and compete in the production.

* * *

Make a Scientific Investigation of the Import Trade

(A. J. Latornell, City Engineer, Edmonton, Alta.)

Without a doubt there are great possibilities of developing trade within the Empire. The volume of foreign trade now being done, and the still greater volume transacted prior to the outbreak of the war, is an indication of this.

We now have an opportune time to set about increasing our trade with the various parts of the Empire. This must be undertaken in an intelligent manner, however, otherwise our efforts will meet with failure. At this time we might succeed in selling unsatisfactory goods, owing to the fact that no others were obtainable, but such a trade would prove detrimental, as we should inevitably lose it when conditions returned to normal. The proper thing to do is to ascertain what each country imports and the country from which it is imported, and then study the article of trade in order to ascertain just why it meets the demand in that particular country. The article may have some particular feature in its manufacture, or its recommendations may be only of a trifling character. Price is always an important consideration. Trade relations are best maintained and improved on the principle of an honest article at an honest price.

As far as Canada is concerned, my idea of the best way of developing trade is to place in various centres a sufficient number of properly trained and intelligent men (not politicians) to study this problem and report upon it. To flood any country with sales agents, until the requirements were known, would be unwise. An intelligent, persistent campaign would produce results, and for a country with such resources as Canada the possibilities are boundless.

* * *

Roadmaking Machinery and Equipment

(W. A. McLean, Provincial Engineer of Highways for Ontario.)

Road construction is developing into an undertaking of large proportions, to be carried out by means of specialized plants of machinery and equipment. The manual labor of half a century ago has been replaced largely by labor-saving appliances. Stone, which is the basis of road construction, is no longer broken by hand and consolidated by traffic; it is broken by rock crushers and rolled into place by steam rollers, and the tendency is to displace team haulage by mechanical traction. A more durable type of road has resulted, and the tendency has been to reduce cost—a vital necessity in view of the increasing standard of wages. It is felt, however, by highway authorities that the cost of road construction and maintenance is still too great. The ideal of a durable pavement for $1.00 a square yard is very attractive, and, if attained, would do much to stimulate road improvement.

More may be anticipated in cost reduction from machinery development than from any other discernible source. Machinery for the cheaper and more efficient construction of bituminous roadways in the open country can be developed profitably. Machinery of a lower cost for handling broken stone from the car or stock pile to wagons would fill an important need, as manual labor in this work is inefficient and expensive. A machine is needed, easily portable and of comparatively low cost, such as County and even Township authorities can afford to purchase and operate. Advance may be anticipated in the use of mechanical traction for hauling road material, especially as a result of experience with motor trucks in the war.

Road construction is a matter which must find increasing support as the years roll on. There will be a growing demand for machinery throughout Canada for this purpose. Australia, South Africa, India and all the lesser colonies are feeling the impetus to road improvement. To satisfy this market within the Empire, on a broad scale, should be financially profitable and attractive. It can only be done, however, by men and firms who are willing to study the road situation, and to supply such machinery (and only such machinery) as will in the end prove satisfactory to their customers—corporations, engineers and contractors.

* * *

"What We Haven't Got We'll Make—or Do Without"

(Wm. B. Mackenzie, Consulting Engineer, Moncton, N.B.)

An industry which should pay in the eastern part of the Dominion is a creosoting works. The people should demand that all Government structures built in wood, such as wharves, breakwaters, railroad ties and bridge-floors, should be creosoted or treated with some good wood-preservative. The forests are now being depleted and one-half the wood cut is either wasted by being left to decay in the forest, or is allowed to rot after being erected, for want of a preservative. We now export creosote and bring it back in creosoted timber. At the present time we are using many things made in the countries of our enemies.

Hereafter our motto should be "What we have we'll hold, and what we haven't got we'll make—or do without."

* * *

Large Quantities of Boiler Tubes Needed

(Marsh & Henthorn, Makers of Hoisting Machinery, Belleville, Ont.)

Large quantities of boiler tubes are needed in Canada, and there is a good opportunity for establishing a boiler tube mill, as practically all of the tubes now used are imported from the United States, Germany and Belgium.

We would suggest the compilation of a list of the boiler manufacturers of Canada from whom there might be obtained a list of the different sizes of boiler tubes used under normal conditions. From the information procured from various sources an estimate might be made of the quantity of tubes used annually in this country. Such an estimate might be of sufficient interest to manufacturers to induce them to start the manufacture of boiler tubes in Canada.

* * *

Clay Industries of the West

(T. B. Merriam, Consulting Engineer, Winnipeg.)

The clay industries of Western Canada could be developed to the great advantage of all identified with the constructional industry. Sewer pipe and the better class of brick are imported largely—to the great disadvantage of the user—and sand lime brick is used in considerable quantities where clay brick, in my opinion, would be better.

It should be part of the tactics of war to secure the enemy's market. This would mean our developing along the line of chemical products—especially those derived from tar.

In putting these suggestions into practice, we should be attracting greater attention to chemical engineering in our university courses. Conservation and development alike would thrive under the influence of strong faculties and under the work carried out in well-equipped laboratories for practical chemistry.

* * *

Chloride of Magnesium—Raw Material from Quebec, but Made in Germany

(J. B. Mitchell, Commissioner of School Buildings, Winnipeg, Man.)

This war has shown the lamentable extent to which the Dominion is dependent upon Germany and Austria for material which should be manufactured at home.

In several new schools the specifications called for jointless flooring, which is being used very generally on buildings of reinforced concrete. Into this flooring chloride of magnesium enters largely. This, it appears, is manufactured in Germany, although the raw material is said to come from the Province of Quebec.

Surely there is an opportunity here for some enterprising person!

* * *

The "Possibilities" which will Follow the War

(L. G. Chiozza Money, M.P., of the British House of Commons.)

The war has revealed to us that owing to the neglect of British investors, some new industries have not been taken up and other old ones have languished. After the war a greater proportion of investment will be made at home. If the Government does its duty, it is certain that British capital investments will increase.

I am asked where the stimulus of industry is to come from. Here is a category:

1. Much reconstruction will take place on the Continent after the war, and Britain, as one of the three chief manufacturing countries, must be called upon for much material. This is a passing phase.

2. Although war does not disable a country as long as it is commonly supposed, Germany for some time after the war will be greatly handicapped in her competition with us—and German competition is the fiercest we have to encounter. This should enable our industrial captains to strengthen their position and recover lost ground.

3. The war has revealed to an astonished nation that we have neglected important industries. That neglect will be atoned for, so that after the war we shall gain new industries, and improve old ones.

4. It is probable that the deplorable vogue of overseas investing will be checked by the war, and that the new national spirit which has arisen will lead to the enlargement of the scale of our industrial operations.

5. The Government has been forced by the conditions of the war to interfere in industry to save individualism from itself. When the war is over it will be impossible for the old neglect of essential interests to obtain.

* * *

Porcelain Manufactures

(H. Mueller Manufacturing Company, Limited, Sarnia, Ont.)

In the manufacture of our goods, we use a considerable quantity of porcelain handles and porcelain indexed buttons, which we have always had to import. If we could find some place in Canada where these could be purchased, we should be glad to keep our money at home.

* * *

Infusorial Earth Deposits in the Maritime Provinces

(William Murdoch, City Engineer, St. John, N.B.)

I would direct attention to the matter of infusorial earth, known in Germany—where, heretofore, it has been produced almost exclusively—as "Kieselguhr," and in some other localities of Europe as "Berg Mahl." Of this there is an abundant deposit within eight miles of the city of St. John. This deposit covers an area of about fifty acres and is held at present by interests at Providence, R.I. About fifty miles from St. John there is another deposit of a very fine texture and snowy white color. In the neighborhood of Bass River, N.S., there is yet another small deposit.

Infusorial earth is mixed with asbestos in the preparation of boiler coverings; it is used as a fine polish for gold and silver, and it enters also into the manufacture of rouge powder for the toilet.

It dissolves in a hot solution of caustic soda and then becomes water glass or silicate of soda. This, when applied to a masonry wall with a brush and coated with chloride of calcium, causes the chlorine of the chloride of calcium and the soda in the silicate of soda to effloresce in the form of common salt, leaving an enamel on the surface of silicate of lime which is equivalent to glass. If the chloride of calcium be not applied, the water glass will remain soluble and wash off the masonry surface.

There is a variety of other uses, one being a preparation for making wood fireproof.

There has been very little demand for this material, owing to the fact that the world's market has been held for many years by Germany, but now that this trade is dislocated the opportunity occurs to work these deposits in Canada.

* * *

Quebec Builder Offers a Few Suggestions to the English Manufacturer and Makes Strong Plea for Technical Training

(E. T. Nesbitt, Quebec, Que.)

While I regard the theory of "trade within the Empire" as an excellent one, I have experienced some difficulty in putting it into practice, owing to the lack of a something which I can hardly describe. It may be lack of energy, or possibly a certain incapacity for getting business on the part of the man selling the goods. As an illustration, a short time ago I wanted to put in a certain piece of machinery in my woodworking plant. By correspondence, catalogues, etc., I obtained all possible information from Canadian and U. S. makers. The American machinery seemed far ahead of the Canadian machinery, but then I received a catalogue from England relating to a machine which would do the very work required and at a much lower price. The description of the machine was indifferent, however; the terms employed were not familiar to me, and I could not get the clear meaning of them, so I wrote several letters for more particulars and received explanations from the English firm. But whether they did not understand me, or I could not understand them, we arrived at no understanding. In the end I gave up in despair and bought an American machine. I am still ignorant of the merits of the English one.

If the English manufacturer is going to develop the Canadian trade he must come over here with his samples, display them in a show room and exhibit them at our Fairs, giving us an opportunity to make an actual comparison and get in direct touch with the principals, just as the United States people do.

To manufacture within the Empire is to encourage its trade, but technical training and skilled labor are required, and these we do not possess. For example, a company here manufacturing rifles for the Dominion Government has secured immense business from England owing to the war, but it has had to bring in skilled labor from a foreign country. When the war is over these men will return to their homes without having made any contribution to the development of trade within the Empire. Here is an opportunity. The war is giving an impetus to this industry, and if we had skilled workmen the trade could be carried on to the benefit of the Empire.

We must look to our facilities for technical training. In this there is no reflection upon what has been done. The provincial governments, in fact, are doing very well. The province of Ontario has provided well-equipped schools in Toronto, while the province of Quebec has one in Montreal and one in Quebec City. The authorities have done their duty at considerable expense, the buildings are well equipped and the professors are capable men. But more remains to be done; more must be done. Parents must be awakened to the advantages of technical training and boys must be educated to seek it. The Quebec school has now been open three years and I am sorry to say that it has made very little progress in point of numbers. Surely such work as the Rifle Manufacturing Company is carrying out should be essentially an industry within the Empire, but I understand that the material and tools for the manufacture of these rifles are imported. If this is so, what can be said of it?

* * *

Steel Sections

(A. B. Ormsby Company, Limited, Toronto.)

There have been imported from German mills, through agents in Montreal and New York, large quantities of hot rolled steel sections for use in the building of steel cornices for exterior and interior, steel stair risers and stringers, hand rails for stairs and balconies, steel sections for balustrades, newel posts, steel jambs, and steel trims. We refer to the lines manufactured by Manstaedt and to the J. G. Braun sections imported by way of New York. These sections are used extensively in building construction, and they are employed largely by manufacturers of ornamental iron, elevator fronts, metal stairs, and so on. As we are manufacturers of steel trim, which is rapidly superseding wood in all high-class construction, we are naturally equipped to turn out all kinds of shapes in steel. We can furnish not only steel sections in any shape, size and weight, up to and including No. 11 gauge, which is equal to ⅛-in. in thickness, but bronze, copper, or other metal sections required by the trade. We gladly offer our engineering facilities to any who care to work out any problems involving the use of material of this kind.

* * *

Mild Steel Pipe and Boiler Tubes

(Page-Hersey Iron, Tube & Lead Company, Limited, Toronto, Ont.)

During 1914 we installed machinery for making mild steel bell and spigot pipe in sizes from 3 in. to 10 in. in diameter. This material replaces pipe that was imported formerly from Germany. It is adapted particularly for the use of cities in the installation of water-works and gas mains. This class of pipe is much lighter in weight than cast iron, and it will stand higher pressure by reason of the greater density and tensile strength of steel. It is protected from oxidization by being coated with a special non-corrosive material, and it is further reinforced by being wound spirally with burlap, which has been run through a molten bath of the same compound. This pipe has been used successfully in several large installations, including those of Calgary, South Vancouver, Point Edward, Stamford, Tottenham and Smith's Falls. Importations from Germany, which were large, have now entirely ceased, owing to the war, but our municipalities will suffer no inconvenience, as the Canadian product is even cheaper than the German product was, when the customs duty is taken into consideration. This is a new field for Canadian enterprise and one which will promote the welfare of Canadian workmen.

We noted, with much interest, in a recent issue of the Contract Record, the suggestion that there was a sufficient demand for boiler tubes to warrant their manufacture in Canada. This is undoubtedly true. Some few years ago we equipped a plant at Welland, Ont., for turning out this line of goods. The plant was a combination mill for making boiler tubes and lapwelded steam and gas pipe. The difficulty in connection with boiler tubes is that they are on the Canadian free list, whereas all the raw materials from which to make them are dutiable. This renders their manufacture in Canada at present a commercial impossibility. It is to be hoped that in the near future the Dominion Government will take steps looking to the manufacture of this article in Canada.

* * *

Numerous Openings for Capital and Enterprise in the Maritime Provinces

(J. E. Parker, Town Engineer, Amherst, N.S.)

The great basic industries of the Maritime Provinces afford splendid opportunities for the development of trade within the Empire, and we are especially favored with transportation facilities. The great difficulty that has always stood in the way has been lack of capital coupled with a lack of that enterprise which makes for the development of new lines of industrial activity. These provinces are rich in agricultural possibilities, lumber, iron, coal, gypsum and other minerals, and their fisheries are of enormous value. Natural gas is found in New Brunswick and is believed to exist in Nova Scotia. There are enormous beds of valuable oil shales. New Brunswick and Nova Scotia have valuable water powers. Both are thoroughly intersected by railways, and have a great length of coast line with fine harbors. At the present time a movement is afoot—it having been launched by representative men of all the Maritime Provinces at a great meeting in Amherst, and resulted in the organization of a Maritime Forward League—the purpose of which is to encourage development in every direction, increase production, and find new and profitable markets for Maritime Province products. The changes brought about by the war have led such corporations as the Dominion Iron and Steel Company and the Nova Scotia Steel Company to make a strong effort to find new markets on the other side of the Atlantic and in South America for articles which hitherto have been produced by countries in the present war zone. The possibilities, even in manufacturing, for outside markets, are shown by the fact that nails and brass goods, manufactured in St. John, have, for some years, been exported to Britain, Australia and other distant markets. The products of Maritime Province industries are sold throughout Canada, and the development of profitable foreign markets is merely a question of capital, of proper representation in those markets, and the production of lines of goods such as they have been in the habit of getting from countries which for the present—and for a long time to come—will not be in a position to supply the goods.

With regard to the lumber industry, there are excellent opportunities for the development of the pulp and paper trade. Enormous quantities of pulp wood are available. Every year the provinces of New Brunswick and Nova Scotia export hundreds of millions of feet of lumber in a roughly manufactured state. There is no reason, except the lack of capital and enterprise, why a much greater variety of wood-working industries should not be established—exporting the products in a more highly finished state. There is also an abundance of hardwood, in birch, maple, and beech, which is practically not used at all for manufacturing purposes. The manufacture of furniture is one branch of industry that is capable of development; and there are others.

The fisheries are capable of much greater development than has even yet been realized. The waters around these provinces produce enormous quantities of merchantable fish, but the best means has not yet been adopted for taking, curing and finding markets for them, as has been done in connection with the fisheries of some other countries. These waters yield herring, cod, haddock, hake, halibut, salmon, lobsters, oysters, alewives, and the little herring of which sardines are made. With better curing and marketing, this trade can be developed and made much more profitable.

With regard to agriculture and the raising of live stock, especially sheep, the resources of these provinces have hardly yet begun to be developed. There is room for the establishment of commercial orchards on a very large scale, and with good prospects. It has been suggested that sugar beets could be profitably raised, and indeed experiments have shown it, while canneries might also be established.

There remains the mineral wealth. With iron, coal, lime, gypsum, granite and immense beds of oil shales, it is perfectly clear that the natural conditions are entirely favorable to a profitable development, if proper judgment is exercised and intelligent efforts are made to secure outside markets. When capital and enterprise are yoked together, as they should be for the development of natural resources, the Maritime Provinces will become noted for the variety and extent of their manufacturing industries.

* * *

Paving Blocks

(R. H. Parsons, City Engineer, Peterborough, Ont.)

Two years ago we had need for paving blocks in the city of Peterborough. In order to get quick delivery it was necessary to go to the United States for them. There did not seem to be any manufacturers of first-class paving blocks in Canada. Surely somewhere in this great Dominion there are deposits of clay suitable for the manufacture of first-class blocks—if not in Canada, in the British Empire!

The cities of Canada must purchase large numbers of these blocks every year. Why not spend this money with our own people, instead of sending it over to the United States? With the freight and duty against United States manufacturers our own manufacturers should be able to compete with them and give us a first-class block.

* * *

"Made-in-Canada" Building and Municipal Supplies

(Chas. E. Parry, City Engineer, Fort Frances, Ont.)

To my mind there is a great scarcity of "Made-in-Canada" building and municipal supplies. In preparing specifications in these lines I experience great difficulty in finding suitable materials that do not have to be imported from the United States. Why is this, when we have large quantities of raw material, which, if developed and manufactured in Canada, would meet all our demands? If this matter were kept before readers of the Contract Record it might be productive to some extent and help various lines of activity in the Dominion.

Now is the time to bring such matters to a head before other competing countries get into the field. There is no reason why Canada, with the Mother Country, should not look after the requirements of both countries.

* * *

Steel Columns, Glazed Terra-Cotta, Glazed Brick and Other Materials

(S. H. Penlington, A.R.I.B.A., Architect, Toronto.)

The "possibilities of developing trade within the Empire" are undoubtedly numerous. For instance, the extent to which Bethlehem steel columns have been used lately by structural engineers and architects would suggest that they should be rolled in Canada. The steel billets could be obtained from the Scotch or English iron works, as is done now in the case of the smaller beams and columns. For their manufacture in this part of Canada, power can be obtained in abundance from Niagara. The demand for such steel sections is ever-increasing, but the supply continues to come from Pittsburgh. We have to thank Pittsburgh for the splendid steel shapes manufactured in that city, but I cannot see any reason why we ourselves should not roll them.

Other items which suggest themselves forcibly to my mind are glazed terra-cotta, glazed brick, and materials of a similar nature. There is a market in Canada for these materials in large quantities, but the bulk of the supply comes from across the line. This is because the United States manufacturers were the first in the field and because they command a riper experience in the manipulation of good clay.

Here surely is an opportunity: we can obtain reliable information concerning our clays from the Mines Branch at Ottawa; and the other materials required in the manufacture of terra-cotta, such as sand, ground glass, etc., are obtainable here just as readily as in the country to the south of us.

* * *

Colored Clay Products

(Harry Edward Prindle, architect, Montreal.)

The possibilities of creating trade within the Empire are practically unlimited, and the result of really constructive thought and work along these lines would certainly mean the greatest good to the largest number.

The idea should prove an inspiration to the man who is interested in producing work that is worth while, aside from the matter of dollars.

As an illustration, colored clay products for interior and exterior decoration of buildings are not made in Canada, so far as the writer knows.

The crux of the matter lies in a disposition on the part of the manufacturer to produce an article equal in every respect to that produced elsewhere—at a reasonable price.

* * *

"Surveying and Mathematical Instruments, and All Classes of Road Machinery

(George Reakes, Town Engineer, Beaconsfield, Que.)

The possibilities of developing trade within the Empire —and more so in Canada, with its vast resources of minerals —were never greater than at the present time. The events taking place in Europe must bind the Empire in closer trade relationship.

Surveying and mathematical instruments, and all classes of stone crushers and road machinery, could be manufactured here, instead of being imported from Germany and the United States.

* * *

Imports of Steel Manufactures Too High

(W. Blaine Redfern, Town Engineer, Sarnia, Ont.)

Trade within the Empire is like the circulatory system of our bodies. Without it our far-flung heritage on every continent, lapped by seven seas, on which the sun never sets, would languish; the distant parts as an integral part thereof would die. But with an ever-increasing trade in this world-encircling union, joined together by the intangible bond of sentiment and a common partiotism, the life and interest of each separate part would be stimulated and sustained. And this especially in an Empire within whose boundaries practically all the necessities and luxuries of life can be produced or found. As far as practicable, therefore, let there be a greater incentive by trade restrictions and trade preferences for the people of the east and west to enjoy the products of the labor and genius of the people of the north and south, and vice versa. This should be easy to attain in an Empire which, in the awful conflict in Europe, has displayed such a common patriotism, a zealous and unselfish love of country, as to produce the spectacle of the immediate cessation of domestic troubles at home and the healthful emulation of the self-governing dominions and colonies beyond the seas, in an effort to support the Mother

Country in her hour of trial against the militarism, aggression and arrogance of Germany.

In this district particularly, surrounded as it is by the large iron zones, much industry will be needed and patience required in its development in order to help supply the needs of the Empire. The steel industries of the Lake Superior Corporation, located here, are too well known to need mentioning. Why should Canada as a part of the Empire still import yearly such large quantities of steel manufactures, when a good deal of the development and manufacturing might be done in our own country? In the town of Steelton, which has the strategical position for the further development of the iron and steel industry, there are good factory sites and cheap power. May they be used to good advantage soon.

* * *

An Educational Campaign Required

(W. E. Robertson, of R. Robertson & Sons, Limited, general contractors, Toronto.)

As far as using British material in construction work is concerned, an educational campaign will have to be carried on by the English manufacturers and jobbers among the architects and engineers here, so that their products can be specified. To do this effectively they will have to have direct representatives in Canada. We have always found the manufacturers' representatives in Canada very aggressive. It seems to me that this is a profitable field to cultivate. A good plan would be to get in touch with the manufacturers' agents and get their ideas as to the prospects of selling and adopting British products effectively.

* * *

Why Not Lead Pencils?

(John H. Shaw, Town Engineer, North Bay, Ont.)

I wonder whether it has ever occurred to any of our manufacturers that there is an opportunity now for making lead pencils in this country. Hitherto nearly all the lead pencils we have been using have been "Made in Bavaria." Why not lead pencils "Made in Canada"? We have an abundance of graphite and other materials required in their manufacture, and I can see no reason why this industry should not be made worth while.

* * *

A Well-Known Montreal Architect Suggests Many New Lines: Brick, Glazed Terra-Cotta and Roofing

(Philip J. Turner, F.R.I.B.A., Montreal.)

I am of the opinion that there is a splendid opening in Canada for the manufacture of a superior facing and vitrified brick. Is it not a fact that no vitrified bricks are made in the Dominion, and that all the better-class bricks are imported from the United States? With the prospects of increased freight rates ahead of the United States manufacturer, there is opened up a good field for our own people engaged in this industry.

Then there should be good business openings in the proper quarrying of our Canadian building stones. In many places excellent varieties of this material are to be found, but very few companies have shown enterprise enough to establish plants of sufficient capacity to handle the stone in large quantities. There are notable exceptions, but in many cases architects have had to contend with an uncertain supply of various stones that have been brought to their notice, with the result that they have had to specify an American stone in place of the Canadian.

As yet, we have not any manufacturers of glazed terra-cotta in Canada. This material is becoming increasingly popular in the Dominion, and the bulk of the market should not be in the hands of the United States.

Another point is that architects would like to have the advantage of using several well-known English building materials, such as the famous Broseley red roofing tile and Westmoreland green slate. If such materials were readily available on this side of the ocean, what an improvement we might see in the roofing of many of our domestic buildings! Would it not be possible for some enterprising manufacturers' agent, with profit to himself, to stock quantities of these materials over here in Canada? However much these materials may be admired or desired, architects and clients cannot afford to take the risk of ordering them from England on their own account, when information as to cost, etc., is so indefinite as it is at present.

In shipping roofing material over to this country, better arrangements would have to be made so as to avoid breakage in transit, but it is fair to assume that such arrangements could be made by the right man. As it is, the field of roofing materials is so limited that we sigh for something different from the "unfading" American green slate, with its hard lines and monotonous color, and the elaborately shaped and heavy red American tile.

Lastly, one would like to see the importation from India of that most valuable timber, teak, common enough in England, scarcely heard of in Canada, but certainly the best weather-resisting wood known.

* * *

"German Goods for Germany and the Overplus for the World"

(Western Steel & Iron Company, Limited, Winnipeg.)

Germany's success in trade was attributable to two fundamental reasons. The first of these is that Germany made a rule of—**German goods for Germany, and the overplus for the world.** In the second place, they brought scientifically-trained men, with scientific methods, into every trade problem.

Canadian manufacturers need not expect sentiment to influence business to any extent. If the Canadian public can buy goods equal to or better than those obtained from outside sources at the same price or lower, they will get the business; otherwise they will not. Never yet has a wave of sentiment created by conditions such as are prevailing at the present time upset fundamental economic laws. It behoves the Canadian business man and manufacturer, therefore, to grasp the present opportunity and bring science, efficiency and economy into the operation of his business. With this opportunity behind it, the trade of Canada will increase rapidly. Established on a sure foundation, it should grow in the same way that the trade of the German nation grew before this great calamity occurred and shut off Germany from the world's markets.

* * *

The Methods by which Germany Built Up a "Huge Foreign Trade"

(R. O. Wynne-Roberts, Consulting Engineer, Regina, Sask.)

I can only reiterate what I have urged in many quarters for the last ten years, namely, that there is need for a united effort to extend and retain the business of the Empire. I have observed the efforts put forth by Germany, the United States and other countries to secure orders in Canada and other parts of the Empire, and also the co-operative measures taken by them with a view to fostering trade. I appreciate the fact that the Department of Trade and Commerce at Ottawa is encouraging manufacturers and merchants to extend their operations.

The Foreign Office and Board of Trade at London, England, recently issued a Diplomatic and Consular Report on the trade of Germany in 1913. The essence of the report is that combination, syndication and concentration were the noteworthy features of Germany's commercial organization

With such measures Germany was able to build up a huge foreign trade, the expansion of which was phenomenal. May we not attribute this to the features enumerated above?

That there is scope for more united action in Canada can hardly be doubted. It must be remembered that the bitterness of the present moment, due to the conflict in Europe, will soon be forgotten in the commercial world. Buyers will continue to purchase goods in the cheapest market; and if Canada does not organize her forces in conjunction with other parts of the Empire, imports from foreign countries in time will be as great as ever; whereas the Empire, with its great resources, should be able not only to satisfy its own requirements, but also to meet a considerable proportion of the demands of other countries.

The Future of Canadian Commercial and Industrial Development in the Light of the Present War

Specially Contributed by C. E. Dodwell,[*] M. Inst. C. E., M. Can. Soc. C. E.

I am neither a merchant nor a manufacturer—merely an ordinary Civil Engineer, so what I might have to say on this important subject can have no more than an academic interest; but I am glad of the opportunity of joining the chorus of the Press that is trying to arouse the country to the supreme importance of the unique opportunity afforded by the present struggle, of capturing from our Teutonic enemies much actual and potential wealth in trade, commerce and manufactures.

The points at which German industries may be successfully, or at least hopefully, attacked by this country are numerous; but we must not permit ourselves to run away with the idea that even our most vigorous assaults will result in swift or sweeping victories. Indeed we may be perfectly sure that nothing short of united and determined effort will avail.

A comprehensive plan of the battle-field, an indispensable requisite for the initiation of the campaign, is afforded by the following table, showing the value of a few of those articles and commodities which we obtain from Germany in any considerable quantities. The figures, which are taken from Customs statistics, are for the fiscal year ending March 31st, 1914. For the purpose of comparison, the import values from the United Kingdom and the United States are also given:—

Article	United Kingdom	United States	Germany
Total Imports, dutiable	$103,000,590	$262,999,229	$11,176,198
Total imports, free	29,821,154	162,866,783	3,509,871
Total Imports, dutiable and free	132,821,744	425,866,012	14,686,069
1. Baskets	16,948	68,040	22,931
2. Labels, Advertising — photos, chromos, etc., i.e., printed and mechanical art	432,329	1,627,642	174,722
3. Brass, wire cloth	49,746	57,855	32,930
4. Brass, manufacturers of, n.o.p.	249,360	1,744,159	36,097
5. Peas	46,076	108,195	70,010
6. Brushes	114,767	272,281	45,202
7. Buttons	144,606	411,757	83,445
8. Clocks, movements, cases, etc.	63,497	463,875	129,790
9. Combs	63,231	35,892	60,531
10. Cotton, embroideries	255,575	42,270	29,050
11. Cotton, fabrics, printed or colored, n.op.	4,769,311	1,607,468	88,987
12. Cotton, sheets, quilts, napkins, etc.	1,023,744	88,959	31,717
13. Cotton, thread	508,917	271,682	52,400
14. Cotton, clothing, n.o.p. ...	891,710	1,860,435	64,660
15. Cotton, lace	824,072	52,771	107,822
16. Cotton, socks, stockings ...	508,360	170,562	400,740
17. Glue	170,844	37,336	35,780
18. Drugs, medicinal, chemical, etc. (dry)	450,771	524,324	53,693
19. Drugs, dyes, chemical, etc., n.o.p.	269,032	600,338	99,240
20. Earthenware, cream-colored, and n.o.p.	170,152	46,444	23,420
21. Earthenware, table ware ..	1,441,288	41,086	259,123
22. Electric light carbon and carbon points	5,247	37,368	43,308
23. Electric apparatus, insulators, etc., batteries, etc., telegraph and telephone instruments	819,597	5,552,917	141,252
24. Fancy goods, boxes, ornamental, etc.	142,179	124,635	81,066
25. Fancy goods, braids, cords, fringes, etc.	158,637	167,766	76,768
26. Fancy goods, cases for jewellery, watches, etc.	11,783	26,408	38,102
27. Fancy goods, toys and dolls	91,538	293,977	581,069
28. Furs and manufactures of ..	625,793	357,091	255,660
29. Gloves and mitts	1,221,407	324,727	385,843
30. Hops	44,840	356,891	63,413
31. Iron, rolled, including rounds, ovals, etc., n.o.p.	506,994	3,093,957	71,314
32. Iron, ferro-silicon, spiegeleisen and ferro-manganese ..	464,073	98,707	194,999
33. Iron or steel billets	62,746	616,259	68,728
34. Iron, machinery of iron or steel, n.o.p.	1,720,742	12,800,006	165,929
35. Iron skates and parts of ..	180	40,719	42,886
36. Iron or steel tubing	525,552	547,537	237,404
37. Iron ware, granite, etc., hollow ware, etc.	93,385	361,051	93,037
38. Iron, wire of iron or steel, all kinds	16,768	243,901	33,660
39. Iron knives and cutlery ...	607,905	253,711	379,890
40. Iron hand tools of all kinds, n.o.p.	59,245	756,222	56,097
41. Iron manufactured articles of various kinds	924,487	8,904,502	147,377
42. Iron for horse-shoe nails, free	None	32,319	72,495
43. Jewellery, n.o.p.	463,753	1,001,929	151,560
44. Lamps	136,013	875,950	137,710
45. Mineral Waters	55,201	49,655	38,122
46. Musical instruments, n.o.p. (not pianos)	18,078	84,980	138,529
47. Essential oils	68,800	241,843	22,575
48. Optical and philosophical instruments, etc.	269,248	569,284	61,254
49. Paint, zinc white	44,046	208,452	105,872
50. Paper, chief, but not all kinds	1,139,900	3,630,638	320,054
51. Pencils (lead)	60,677	203,343	79,345
52. Sugar, n.o.p., not above No. 16, D.S. in color, etc. ...	None	117,927	999,349
53. Wool, knitted goods, n.o.p.	1,013,430	107,877	98,399
54. Wool socks and stockings ..	1,695,771	70,610	55,823
55. Wool yarns	223,347	3,758	36,649
56. Wool, fabrics and manufactures, whole or in part wool	8,789,821	187,495	233,083
57. Wool clothing	1,472,570	1,011,528	257,248
58. Wool, pressed felt	174,427	110,026	66,571
59. Fur skins, undressed	250,269	1,388,415	411,607
60. Seeds, beet and mangots ...	21,318	11,119	34,785
61. Glycerine, crude, for manufacture of the refined article ..	49,789	9,839	59,577
62. Potash, chlorate and sulphate, crude	10,217	180,765	74,227
63. Tartaric acid crystals	16,315	912	42,333
64. Aluminium, ingots, blocks, bars, etc.	274,974	395,844	37,497
65. Copper tubing	25,108	120,940	41,621
66. Zinc and zinc spelter	135,185	403,385	108,417

Notes on Articles by Numbers

1.—Total importation of baskets from all countries for the year 1913-14 is $159,567. With a protection of 20 per cent. to 30 per cent. and abundant material, one would suppose that we could make our own baskets.

2, 6, 7, 8, 9, 24, 25, 26, 27, 43 and 44.—The large German exports of these goods, and of many others of similar class, are due probably in large measure to the low scale of wages and the low cost of living in Germany—conditions with which we cannot compete to-day; but they are due also, no doubt, to highly trained scientific industry and industrial conditions, the natural development of a highly scientific people, and a densely populated country. The whole matter of fancy goods production should receive the earnest consideration of those of our manufacturers who have factories fitted or equipped in any way for their production.

10-16 inclusive.—The above remarks would apply in some degree at least to these items, but with the numerous cotton factories in Canada, we ought to be able, with a little application, and perhaps revision of methods, to make considerable inroads on Germany's trade. In the item of socks and stockings, which presumably are machine-knit, there does not seem to be any good reason why machinery for the purpose should not be installed in connection with our own factories.

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[*] District Engineer, Department of Public Works, Halifax, N. S.

18, 19, 47, 61, 62 and 63.—These articles are quoted with the object of showing the ascendancy of Germany in industrial chemistry, but the showing is not as conspicuous as it hsould be. There are many articles that come within the range of chemical industry which are manufactured and exported by Germany that do not appear in the quoted figures. It is well known that Germany leads the world in many lines of chemical scientific activities, notably in coal-tar and petroleum derivatives. It is too large a subject for further reference here, but I commend it to the attention of Associations of druggists, chemists and pharmacists.

20 and 21.—We have a number of factories in Canada that turn out earthenware of the cruder sorts, and a considerable increase of business in these lines only awaits their enterprise in the installation of machinery, aided by trained or imported skill, for the manufacture of higher grades of earthenware and crockery. It is well known that in different parts of the country there are extensive deposits of clays suitable for almost any refinement of manufacture.

22 and 23.—There are several concerns in Canada which do extensive business in electrical supplies, and they ought to be able to cut into Germany's trade, at least with the aid of a little more capital and a little more enterprise, and possibly an increased duty.

28 and 59.—To import nearly $700,000 worth of furs from Germany to Canada seems, to a man unfamiliar with the conditions of this trade, to be like sending "coals to Newcastle," and a consideration of our possibilities ought to give a stimulus to the raising and breeding of fur-bearing animals.

30.—The importation of hops from our two enemy countries, Austria-Hungary and Germany, amounts to $156,530. If our brewers can import hops to this extent from Europe, paying a duty of about 15 per cent., what is the matter with our farmers? It is true that hop culture is dependent largely upon low wages, and that in Europe their picking and packing are done principally by women and girls, but they are admitted to be a paying crop, and I believe that our farmers should be induced to give them a fair trial.

31-42.—Many of these items are specialties, the result of highly developed and scientific industry, but there are no adequate reasons in the nature of things why our iron and steel works should not devote their energies to turning out more highly specialized and valuable articles than pig-iron, billets, rails and shapes.

50.—It is notable that our manufacturers have not taken up the production of the higher grades and more expensive qualities of paper, but why this should be so is not easy to understand. Mere lack of enterprise or capital are quite insufficient reasons for the low development of this important industry.

52 and 60.—These items are wholly connected with the beet sugar industry, in the development of which no serious efforts have yet been made in Canada. In addition to these items nearly $61,000 worth of machinery for the manufacture of beet sugar was imported into Canada in the fiscal year 1913-14. Notwithstanding this the output of beet sugar in Canada is under 10,000 tons, while the total consumption of sugar for the whole country is nearly 400,000 tons per annum. The manufacture of beet sugar has been established successfully in England, but as it is yet in its early stages; it is too early to draw lessons from it. The high cost of labor in Canada is an obstacle in the way of the introduction of this industry, but it should not be an insurmountable one.

53 to 59.—The same remarks apply to these items as are given above to items 10 to 16, but with greater force, because, while Canada cannot grow cotton, it is eminently adapted for the growing of wool.

64 and 66.—These items point to the need and importance of greater and more scientific development in our metallurgical industries.

There are many other points that I should like to enlarge upon, but as this is rather a letter than a treatise or magazine article, I forebear.

The main point is that if we cannot, for our own benefit and advantage, keep for ourselves the whole of the $15,000,000 of trade that we have been giving Germany, we must, as a national and patriotic duty, keep it within the Empire.

If every unit of our great Empire would seek its own development first, only in an Imperial and not in a selfish spirit, the united efforts of the parts would conduce to the strength and prosperity of the whole. Possibly as one result of the general campaign there may be realized one part at least of the dream of the Imperial Political Economist—**Free Trade within the Empire.**

In conclusion, let me take this opportunity of calling attention to two very important matters.

First, the Conservation Commission of the Federal Government, established a few years ago as a branch of the Department of the Interior, is doing an admirable work, not only in the conservation, but also in the development and exploitation of the natural resources of the country. It may aptly be styled **The Intelligence Department** of the commercial and industrial forces now initiating a dollar war as a sequel and corollary to the blood war now raging. With the assistance which, doubtless, it will be able and willing to afford, it should be an important factor in the campaign.

Secondly, to secure the advantages that are within our grasp, it is of supreme importance that our attacks on the enemies' strongholds should be organized and systemized in the most thorough manner. To this end I would suggest that all Industrial Societies, Boards of Trade, and kindred bodies throughout the country should hold meetings, appoint committees, and take other necessary steps to co-ordinate their efforts with a view to the prosecution of the campaign in a vigorous and business-like fashion. The Dominion Manufacturers' Association should approach or memorialize the Government in the early days of the ensuing session of Parliament, because radical changes or substantial increases to our present tariff, and other ways and means, will be discussed as necessary to meet the cost of Canada's share in the present titanic struggle, upon which the fate of the Empire depends. The Press throughout the length and breadth of the Dominion should bring home to every man engaged in trade, commerce or manufacture, the fact that he has a direct and personal interest in the campaign, and that his own individual, active participation therein is essential to a successful issue.

Work has been commenced on the water main system for North Toronto by day labor, according to instructions given to Commissioner Harris in connection with relief work. The contractors are now asking that the work be given out by contract, claiming that as many men will be given employment as if the city does the work, and it will keep their equipments busy. Tenders will be called for certain sections to be decided on by the Commissioner.

Mr. R. P. Durham, Vice-President of the John S. Metcalf Company, Limited, Montreal, who opened a London office for the company early last year, has been on a visit to the United States and Canada. During last year Mr. Durham spent two months in Russia and also visited other Continental countries. His company are now engaged in building two elevators for the Guinness Brewery Company, of Dublin. He has now returned to London.

Major E. G. Meredith Cape, 21st Battery, Montreal, is in Kingston taking a special military course. Major Cape is president of E. G. M. Cape & Company, Limited, engineers and contractors.

The Need for an Increased Duty on Hydrated Lime

THE Canadian lime manufacturers would appear to be justified in demanding an increase on the duty on hydrated lime from the United States, which is now being imported into this country at the low rate of 17½ per cent. In urging such action on the part of the Government, a correspondent of this journal expresses the opinion that Canadian manufacturers are entitled to protection, and that they should have the advantage of what business is offering in this line, so as to keep their plants in operation and find employment for Canadian labor. The manufacturers of Portland cement have a protection of $2.50 per ton, and the manufacturers of calcined plaster $3.00 per ton (including the duty on the bags), while in the case of hydrated lime the protection is less than $1.00 per ton.

American manufacturers are reported to be selling their hydrated lime as low as $5.00, including paper bags. The price in the United States home market varies from $5.50 to $6.50, but it is not less than $5.50 per ton, including bags, f.o.b. works. This would appear to indicate that the United States manufacturer is shipping lime into Canada at from 50c to $1.00 per ton less than he is charging for the same product in his own territory.

It is suggested that the duty on hydrated lime be made the same as on plaster, i.e., 12½c per 100 lbs. or $2.50 per net ton. If the Government would give this increased protection it would be not only a source of protection to the Canadian manufacturer, but a source of additional revenue to the Canadian Government, while the price to the consumer would not be advanced.

While not accepting the responsibility for these details, the Contract Record has reason to believe that they may be accepted, as thew emanate from a most reliable source. Granting the accuracy of the figures, the duty on lime would appear to be disproportionate and the matter should be rectified immediately by the Government.

The Status of Toronto's Twenty-Five Million Dollar Harbor Scheme

THE plans prepared during 1912 and 1913 for the development of Toronto's entire waterfront called for an expenditure of approximately $25,000,000. The scheme is of such magnitude and importance that an issue of this character would not be complete without detailed reference to its present status.

Contracts have already been let by the Dominion Government and the Harbor Commissioners to the amount of $11,000,000, both contracts having been awarded to the Canadian Stewart Company. During the season of 1914 over 3,700 lineal feet of crib-work substructure was built for the Western Breakwater—i.e., on the Western Section between the Western Channel and the Humber River; and approximately 10,000 lineal feet of substructure was built for the dockage and retention work in the Eastern Section, or what is known as the Industrial District, i.e., strictly applied to the Ship Channel, Marginal Way and Northern Slip construction.

So far as the dredging contract is concerned, the dredge "Shuniah" with a 20-in. pump started on June 18th, and remained in operation on the Commissioners' work until early in October, after which the new dredge "Cyclone," which was constructed specially by the Canadian Stewart Company, came on the work on November 6th. For the season these two dredges handled approximately 800,000 cubic yards, with an average length of discharge pipe—in the case of the "Shuniah"— of 2,500 feet. This meant an average capacity of a little less than 300 cubic yards an hour, at that distance, while in operation. The dredge "Cyclone," with a 24-in. pump, averaged 1,079 cubic yards an hour while in operation, with an average discharge pipe length of 4,544 feet.

It is contemplated for the construction season of 1915 that the work will be continued so far as the Western Breakwater is concerned, and also as regards the work on the Ship Channel, Marginal Way and Turning Basin. This means that the superstructure will be finished on much of the substructure work now in place, and that substructure work similar to that done in 1914 will be continued during 1915, the superstructure being placed on the 1915 work during the construction season of 1916.

So far as the dredging is concerned, the Harbor Commissioners' own dredges and the work to be done on the dredging contract by the Canadian Stewart Company will, in all probability, exceed 4,000,000 cubic yards.

The total estimated expenditures for the construction season of 1915 will be about $2,000,000.

The Words of a Friend

(New York Sun)

THERE could be nothing more graceful in expression or profounder in significance than the address issued by the Executive Committee of the Canadian Peace Centenary Association on the occasion of the one hundredth anniversay of the signing of the Treaty of Ghent.

It is a century "since British and American arms have been matched in national strife." In the midst of an earth-shaking war, in which Canada herself is engaged as a unit of the British Imperial system, the Dominion points to the unguarded frontier, more than three thousand miles long, dividing her territory from that of this republic, and says: "We are convinced that the dealings of the great empire and the great republic afford a noble example for the rest of the world. They remain as an ideal in international relations."

And the Dominion points to the century of peace, with its constant increment of friendliness and good understanding, and says, "May many more follow it!"

May no century except of unbroken peace ever follow it! And, The Sun begs leave to repeat, let us thank Heaven for our neighbors to the north of us!

The Cedar Rapids Power and Manufacturing Company are now delivering power in Montreal and elsewhere, all the new steel pole transmission lines between Montreal and Cedars Rapids, and between the power plant at Messina Falls, having been completed.

The Ontario Hydro Commission have order a reduction in rates in the various municipalities concerned. The reduction will save the light and power consumers $200,000 per annum in addition to the $150,000 per annum saved by the 1913 reduction.

Wake Up Canada!

Specially Contributed by Henry Dalby, Montreal

IN Canada, as elsewhere, people are dominated to a great degree by phrases. Elections are fought and won on "war cries"; and business is controlled upon supposed principles, embodied in terse phraseology, the language of which is easily remembered, if the principles laid down are often misunderstood or misapplied. Just now the business motto is "Made in Canada," and it affirms the patriotic duty of the Canadian consumer to buy at any cost articles of Canadian manufacture, no matter how inferior in quality to the imported article.

The principle is based upon the hazy notion that the phenomenal development of German industry since 1871, and especially in the latter part of that period, was due to the patriotic determination of the German consumer under Imperial inspiration to restrict his purchases, as far as possible, to articles "made in Germany." As a matter of fact the motto "Made in Germany" itself was actually made in England, and was affixed by British law upon articles manufactured in Germany as a distinct stigma of inferiority. This was done not simply to protect the British manufacturer from the unfair competition of the German cutler, who sold knives made of hoop iron as Sheffield steel ware, but to protect the British consumer from German imposition.

In Germany, as everywhere else, the brand "Made in Germany" was regarded as a sign equivalent to "Cheap and Nasty," and even now it is so interpreted by the Kaiser's own subjects. The same might be said of some of the things made in Canada, only for the serious objection that they are not cheap.

I believe in the reasonable protection of Canadian industries by the tariff; but only as a means to an end in the interest of the whole nation, and because the policy is forced upon us by the contiguity of the United States. It is no legitimate part of the principle of protection to encourage the Canadian manufacturer in the exploitation of the Canadian consumer. Other things being equal, the buyer, by all means, should give the preference to the Canadian-made article. Above all things we should get rid of the silly superstition that anything is the better because it is imported.

Not everything can be made to advantage in the Dominion. There are many things which depend for their production upon the cheap labor of races with a restricted number of special aptitudes developed by training for many generations in work done without the aid of machinery. From our point of view their standard of living is low; their wants are few; and consequently they make poor markets for our most profitable industries. For instance, in the making of flimsy gimcracks of paper and bamboo, with novel and characteristic ornamentation, many of the Oriental races excel. Their products display an infinity of patient toil, some artistic taste, clever handicraft, and a cheapness which forbids competition by people who require more than a handful or two of rice a day to live upon. Whether the product is worth even the small price it costs is another question. Sometimes it is, and sometimes it is not.

In any case very low standards of living are not desirable for the Occidental world. Granted, most of us western people spend our substance for that which is not bread; and if we were willing to live on a monotonous diet of rice, we might be in a better position to compete for the markets of the world. But what is needed is not so much a penurious scale of living, or a great reduction in the wage-earning capacity of our laboring classes, as a radical improvement in habits, based upon more educated tastes, and with more regard for thrift and more forethought for the ever-impending rainy day.

Another and perhaps even more practical and really insurmountable obstacle to any scheme of economic reform based upon the adoption of a lower wage scale, is that the workman will not have it. In war time and other times of storm and stress, they may consent to temporary curtailment, but they will never consent to compete permanently with the German for any line of business which involves the adoption of the German scale of wages, in a country where the American scale of prices for the necessities and little luxuries of life and the western habits of life prevail. The two things of course act and re-act upon each other.

The most prosperous times, however, are not when the tailor and his family wear their old boots down at the heels and with holes in the uppers, and the shoemaker and his family wear their old clothes threadbare. The best times are when each patronizes the other freely and both are kept busy.

All Must Co-operate

What we have to do is to co-operate one and all, workmen and capitalists, bankers, scientists, transportation companies and governments, for the development of those lines of industry to which our people and climatic conditions are adapted, for which we have most of the raw materials, and which contain the promise of remunerative results for all concerned. There are plenty of such industries to be developed, without troubling about lines which are essentially exotic, and which are almost as necessary to our well-being by providing scope for our foreign commerce. In one form or another, in the long run, exports and imports must about balance each other. The greatest difficulty in the way of foreign commerce since the opening of the war has been the want of foreign exchange.

I have always been a strong advocate of Imperial Preferential Trade, although I doubt whether the Imperial Preference need be or can be embodied in tariff legislation. Many sections of the British Empire are so complementary to each other that the Empire as a whole can be self-supporting. If the people of the United Kingdom, its Dominions and Protectorates, really prefer to trade with each other, that is the highest kind of Imperial Preference; and legislation should not go much farther, although the contiguity of the United States and Canada introduces a perplexing complication into the problem.

We must, however, remember that in these days distances are not measured in miles, but in dollars and cents. The question is not how far a bushel of wheat or a ton of coal has to be carried to this market or to that, but purely and simply how much will it cost to transport the goods. It actually costs more to carry farm produce from some parts of England to London than it does to carry similar products from the Canadian west to the same market. It is a matter of facilities, of quantities, of good roads, railways, and steamship freights. In this the Germans have the advantage (which is not without its disadvantages) of government railway ownership. In Canada, however, this is largely offset by our admirable Railway Commission.

This Dominion is far ahead of Germany in natural resources, and Canadians are by no means inferior to Germans in ability. The one thing we need to adopt from the Germans is their comprehensive system of organization and co-operation between the various industries. In the Kaiser's country they thoroughly appreciate the fact that the by-product of one manufacture is the raw material of another and perhaps a more profitable one. This is as true on the farm as it is in the gas factory. Elsewhere I have repeatedly urged the appointment by the Dominion Government of a Royal Commission to investigate and study these inter-relationships and bring about the co-operation of all the interests involved. The phenomenal development of German commerce and industry in the last forty years is due chiefly to this kind of state aid.

Industrial Changes Brought About by the War

How true it is that necessity is the mother of invention! Hundreds of new industries have suddenly burst out in the United States, not because the American manufacturers have suddenly awakened to their vast possibilities for profit, but because their own businesses were threatened with paralysis through the want of supplies they have hitherto been getting from Germany. That in many cases they have improved upon the German articles goes almost without saying. Until lately the English toy merchants have been importing their dolls from Germany, because it was admitted that dolls' heads could not be made in England. Since the war the Englishmen have learned how to make better dolls' heads than were ever "made in Germany," and an enormous trade has been lost to Germany for ever. Many British industries being badly crippled for the want of the aniline dyes and other dye stuffs formerly obtained from Germany, a company has been formed with a big capitalization in England to manufacture the dyes and the Government has helped to float the enterprise by buying all its bonds. A difficulty has arisen in this connection because the investors demand from a Free Trade Government prohibitive tariff legislation to guarantee the permanence of the industry after the war. I imagine however this will be got over. Great Britain used to monopolize the whole alkali trade of the world and still supplies nearly the whole of the soda compounds; but the trade in potassium compounds has gone almost entirely to Germany, through the enterprise of the Imperial German Government in sinking the salt wells at Stassfurt, thereby obtaining an inexhaustible supply of potassium in solution and acquiring a property said to be worth billions of marks to the Government, and certainly worth an enormous amount of money to the German manufacturers as the basis of many profitable industries.

The Co-operative Principle in Germany

German industrial development has also been greatly facilitated by the adoption of the co-operative principle between manufacturers. The German Government unlike the American Government rather favors trade combinations for the regulation of prices and the reduction of cost of production. There are two kinds of combination in existence; the cartel, which regulates prices and conditions of sale; and the syndicate, which undertakes the actual sale of the products of its members, while their energies and responsibilities are restricted entirely to the work of production. It is said that there are nearly 600 of these organizations, and a recent report of the Cartel Commission gives a list of 385 cartels and syndicates. Of these 132 are in the brick and tile industry, 27 in cement, lime, etc., 62 in iron, 19 coal, 31 textiles, 46 chemicals, 11 wood and paper, 11 in metals and 10 in glass.

Another form of co-operation which would be viewed with alarm in the United States like that created by the Standard Oil octopus, is the actual amalgamation of competing companies, resulting in vast aggregations of capital, with proportionate power for wiping out independent competition. Mr. W. H. Dawson gives a list of nineteen of these financial and commercial amalgamations with an aggregate capital of $638,750,000, or an average of $33,750,000 each.

In Germany everything is for the State; and the State, before all things, for itself. The tendency of the State not only to create business monopolies but to own them and use them chiefly for revenue purposes, is due to the absolute necessity of getting more money for the Imperial Exchequer if the enormous expenditure upon the army and navy is to be maintained. When the Prussian Government was accused in the Legislature of running the State Mining Department like the Coal Syndicate for revenue chiefly, the reply of one of the ministers was: "I have never concealed the fact that the State acts just as private industry acts—when the wolves howl, we must howl with them." The German governments, Imperial and State, have about reached their maximum taxing capacity, and one of the results of the war, we may confidently expect to be a great increase in the nationalization of industries for revenue purposes.

Admitting the danger to public interest of private monopolies, the Government has broadly hinted its intention of getting rid of the danger by turning them into State monopolies. Such things as coal and iron, mining, potash, coal oil, and distilling will be among the first to fall under government ownership. The State is already the biggest colliery owner; and the potash industry being already a monopoly in which the government is largely interested will soon cease to be even in name a private monopoly.

Prince Bismarck wanted to nationalize the tobacco and brandy industries; and "brandy" distilling became a private monopoly in 1897. It is in the hands of the East Prussian land owners, who grow the corn and potatoes, distill the spirit, and sell it directly to the retailers.

While all this kind of thing is, of course, intensely repugnant to Canadians, who are properly averse to government competition with private enterprise, it is a factor that has to be reckoned with, in competing for foreign trade in lines of German manufacture. How to restrict private combinations for the restraint of trade without incurring the worse evil of government monopoly or government competition is a difficult problem. Government ownership of railways is the general rule in Germany, where it suits the German people, who seem to like being herded by policemen and government officials, and disgusts foreigners; but it is profitable for the State, and facilitates commerce and industry. It is the rule in Australia, where it serves the public well at the expense of the State. It has been tried in Canada, but generally with only very qualified success. Public ownership of public utilities depends upon the people who directly control them. Public ownership of industrial or commercial enterprise is an untried experiment upon this continent and is not likely to be tried except in some unexpected emergency.

There is legitimate scope for the government in initiation and organization and in the collection and dissemination of information and suggestion. In some cases financial aid may be justified, as in the case of the purchase of the bonds of the aniline dye enterprise in England. The principle has already been adopted in Canada by the granting of railway subsidies and iron and steel bounties. The establishment of one industry may be the foundation of countless industries dependent upon its main products or by-products for their raw materials.

Another important aid to Canadian commerce is to be found in the development of what is practically a Canadian consular service. At present the consuls are called trade commissioners, but Sir George Foster has taken up the subject with characteristic ability and energy, and I have no doubt that when the war is over he will secure the recognition of these by the foreign governments as having something akin to consular status. The German consular service is as effective as the German diplomatic service is inefficient and stupid.

Now unquestionably is the time to arouse public interest in Canada in Canada's industrial development; to awaken our people to its possibilities and to a realization of the great advantages we have in the extent and wealth of our natural resources. No eight millions, and for that matter no hundred millions of people, on the face of the globe have such assets lying dormant, such an amount of capital lying idle. Our provincial and municipal governments ought also to be taking an active interest in this question. We have a lot of scattered manufacturing industries in the Dominion, but how many of them are identified with any particular cities? In Europe most of the big cities are identified with some characteristic industries. Manchester cottons, Bradford woollens, Witney blankets, Nottingham lace and hosiery, Birmingham hardware, Belfast linens, and Sheffield steel, are as well known all over the world as Berlin metal manufactures and machinery, Dusseldorf machine tools, Cologne perfumes, Lyons silks, Black Forest clocks, Paris millinery and dressmaking, or Brussels lace.

This is a critical time because upon our present action or inaction depends largely the condition of Canadian business after the war. We must look to our government for education, information, initiation, and organization, because frankly our boards of trade are incapable of grappling with the problems now presented. Their attitude might be fairly described as a "don't know and don't very much care" attitude. But I have a great deal of confidence in Sir George Foster's ability and disposition to deal with the matter effectively. If he does the work he will have the support of those who ought to do some of it but are too incapable or too indifferent. There is a pretty lively boom in some lines of Canadian industry, and some mills and factories are working day and night—some because the manufacturers went out and hustled for business; some apparently because the work was thrown at them and they hadn't enough energy to refuse it. Our American friends will save these people lots of trouble in absorbing new ideas by doing the work for them—incidentally pocketing the profit.

To paraphrase His Majesty King George, when Prince of Wales—"Wake up Canada!"

Canada and German Trade

Specially Contributed by the London, Eng., Correspondent of The Contract Record

THERE can be no doubt that whatever other results accrue from the present titanic struggle Germany is bound to lose a great proportion of the trade she has so assiduously built up in the last twenty or thirty years. The industrial genius of the Germans, their methods of intense application, their highly organized system of government, have made the nation a great industrial community whose wares, stamped with the impress of their painstaking efforts, have been found in every market of the world. The Kaiser—apart from his heroics about "mailed fists" and "shining armour"—has been in a sense the managing director of a business Empire and even on the question of war its commercial aspect has, it is to be feared, been the foremost consideration, with expansion as its most hoped for result. Their ruthless onslaught on the peace of Europe has been coldly calculated as a business proposition, and not the least of their eventual loss will be the disintegration of the trade they have built up as the central expression of their national activity.

With the prospect of such a volume of business being diverted into other channels, it is not surprising that organized efforts are being made to secure at least a substantial portion of it, an effort in which the United States has taken a very active part. It is, however, up to the British Empire to see that this portion of the legitimate fruits of her coming victory is as far as possible secured for the Empire, and Canada has her part to play in the active competition for German trade which is now proceeding.

The editor has requested me to write on this matter for the Empire Number of the Contract Record. Such a subject can obviously be treated from a statistical point of view—quoting the volume, destination and classification of German exports, comparing them with Canadian production, and emphasizing the need of pushing those industries which coincide in the respective lists—but such a mechanical method of treating the subject does not appeal to the writer. It has probably been better done on the Canadian side of the Pond, and the writer would prefer to consider the matter from the standpoint of the average London business man (which may not, however, be precisely his own) and to voice as far as in him lies the general conception of the possibilities opened up. In doing so he will probably reveal prejudices and ignorances which he shares with English business men generally; but revelations such as these will not be without value if they only teach Canadian business men (who should know better) the general trend of commercial opinion in London.

More Business Than Usual

The first point to note is the prevailing optimism respecting the business side of the war. Great Britain spontaneously adopted the motto "Business as usual" during the war, and if there is need of another slogan when peace is signed it might well be—judging from present indications—"More business than usual"! No one has yet written a book on the "Psychology of Commerce," but mental attitudes and national sentiments play an enormous part in the stimulation of trade between countries. This optimism—I had almost written enthusiasm—will find its first expression:

in a strong national desire to realize that inter-Empire commercial solidarity of which—without touching politics—the late Mr. Joseph Chamberlain may be regarded as the most energetic advocate. In the past England has been indifferent as to whether she bought from Germany or from the great self-governing colonies. She has been Germany's best customer and this often to the detriment of those who had a closer claim. That must never be so again. Never again, it is hoped, will the present generation of Englishmen buy abroad where it is possible to purchase from Canada or other of England's colonies.

Empire Consciousness

To one who has witnessed the warmth of the welcome given by the English people to the Canadian troops, the thrill of joy and pride and gratitude at their coming into the struggle to aid the Old Country, it was easy to realize that the Imperial sentiment in its best sense had ceased to be the prerogative of a political party and had become a national enthusiasm. This sentiment, which, for want of a better term, I will call "Empire Consciousness," will inevitably find its expression not only in increased trade between the Mother Country and the Colonies, but in a desire financially to equip the latter with the means requisite for augmenting greatly the present possibilities of competing with Germany for the industrial markets of the world. And Canada, the nearest of our Colonies—with a territory nearly as extensive as all Europe—will be the first to feel the effects of this new impulse.

Is the Field Limited?

At first sight the field for Canadian enterprise to supplant that of Germany seems limited. Germany is essentially an industrial country, while Canada is primarily agricultural. Germany's chief exports are machinery, engines, electrical, optical and scientific goods, paper and paper goods, fine chemicals (chiefly the complex photographic chemicals and aniline dyes produced from coal-tar products) and toys. Canada would seem to be distinctly at a disadvantage as compared, say, with the United States, in competing for this business. In each of the industries mentioned the products are the result of years of specialization, the work of a succession of industrial experts and chemists.

A Few Suggestions

This disadvantage, however, is more apparent than real. In machinery and engines Canada has the nucleus of an industry which can profitably be expanded, if only to meet her own domestic requirements and to save importation. Her coal and iron resources can be developed to this end. Electricity, the essential power for tramways, light railways, lighting and power supply, calls for attention as a potential Canadian industry. Paper is a line in which Canada can most easily secure some of the commercial plums falling from the German tree. Most paper nowadays is made from wood pulp and the excellent work accomplished in this direction by other Colonies should furnish at once an example and an incentive to further developments. Practically all the colored, embossed and grained papers used in bookbinding and numerous small stationery articles, for European consumption, have hitherto come from Germany. There is no reason why with her immense lumber wealth Canada should not in time become the foremost paper making country in the world. One cannot speak so confidently regarding the prospect of similarly appropriating the fine chemical trade. Great Britain, as is generally known, is actively following up this opening by means of a State subsidized company with £3,000,000 capital, and her old established chemical industries stand an excellent chance of making this a success. In this connection it is of interest to note the announcement that the Standard Oil Company, which has hitherto supplied certain oil products to Germany for this industry, now intends to enter the market as manufacturers of the fine chemicals made from them.

Timber and Fuel

Obviously, then, Canadian developments must follow closely the line of her own resources. Reverting to the timber question, there should be a big market for small wood manufactures for domestic and other purposes. Barrel making and cooperage is another industry capable of expansion, while in the toy trade, which Germany has hitherto made her own, wood is the material chiefly employed. A class of wooden toys (perhaps of quite new design) made in Canada of Canadian lumber, should find a ready market in the Old Country. America invented the Teddy bear—the descent to such a puerility must be pardoned—but Canada might not only invent a new class of wooden toy but might see that she keeps the resulting business for herself. The small waste timber from such industries could be worked up into briquettes—a subject which, in relation to peat and coal, has already been carefully investigated for the Department of Mines, Ottawa, by Mr. E. Nystrom. The method of patient, careful investigation which has been applied to the briquette, or patent fuel question, would be fruitful of happy results if applied to the other industries mentioned.

Wood Paving Blocks

Wood blocks for street-paving purposes offer another field. The day of the hardwood block, as the only suitable material, has passed, and the opinion among engineers, or among the bulk of them, is that there is little to choose between hard and soft wood so long as the blocks in either case offer equal resistance to wear. A soft wood with a sprinkling of harder blocks is equally bad with a hard wood with a sprinkling of softer blocks. Speaking on this matter of Canadian supply, a writer in the "Surveyor" points to the fact that the Baltic timber trade is mainly controlled by Germans, and this not merely at the moment, but in ordinary times, owing to the fact that Germany has controlling capital interests both in the principal Russian and Swedish timber companies and in timber shipping. "If this is so," he asks, "will the effect not be detrimental to the future use of wood blocks for paving purposes, having regard to the fact that these are mainly cut from timber emanating from Baltic ports? Is it not to be hoped that it may prove possible, by means of the new powerful Canadian ice-breakers which are now at work trying to maintain an open passage through the ice to the White Sea, for timber shipments to continue to come in sufficient quantities from Archangel? But is it a fact that, as a rule, trees grown in such far northern latitudes do not mature to sufficient size to be suitable for cutting wood blocks? As it is an ill wind that blows nobody good, may not one result be that we shall encourage Colonial timber growers to meet our requirements? Should not Canada be able to furnish suitable timber for wood paving blocks at a reasonable price?" Freightage would appear to be the only obstacle.

With Belgian works at a standstill, so far as exportation is concerned, and with the cessation of German imports into Great Britain, iron and steel manufactures offer at least a temporarily extended field for trade between Canada and the Mother Country. Wire nails, cut nails, nuts and bolts, machine screws, barbed wire, and a miscellany of domestic wire goods are greatly in demand. Germany supplied all these articles in great quantities, and the British importer has long since run short of them. To quote one case, so urgent was the demand for wire nails recently that an initial order for 2,000 tons was forwarded to Canada, and, given satisfaction, there will be—doubtless there have already been—more orders to follow. Whichever way the war may turn, there will be a shortage of the goods mentioned for a long time to come, and if Canada can satisfy existing demands there is not the least doubt that the trade she works up, or the greater portion of it, may be retained. In other words, the additional outlay required in building works and laying down plant will be warranted, for the few "lines" mentioned do not by any means cover the possibilities.

Traction Difficulties

The horse is still a useful animal in England, in spite of the enormous increase in motor vehicles. The war has caused wholesale commandeering, and the shortage of equines has been, and is being, keenly felt. Contractors have been very hard hit, for both their horses and their motor wagons, floats, lorries and vans have, to a great extent, suffered the same fate. The motor omnibus services have been curtailed in all large cities, and the harvest which might have been reaped by the resuscitation of the horse-drawn vehicle has failed owing to there being no horses available. Many of the large carrying firms advertise the fact that they cannot guarantee delivery of goods for the same reason. A considerable number of Canadian horses has already arrived to make good war losses, and during the war a succession of shipments will be made; but these will all be for war purposes, and the commercial field still remains an open one and the demand is great. Some of the poor beasts now being used by contractors would be a disgrace to civilization were it not a case of "needs must when the devil drives," while many contractors cannot fulfil their engagement owing to their inability to obtain the necessary "cattle." Motor vehicles, even if available, are not within the purchasing powers of the smaller man, and drivers, too, are at a premium. True, this matter is one that may have no direct bearing on German trade, and the only excuse that can be offered for introducing it is that it has a very important bearing on both contracting and engineering.

Potted Enterprise

Ranching with the allied industries connected with it offers surely a boundless field of activity. I do not know if Canada has anything approaching the meat packing business of Chicago, but if not, there is no reason why she should not foster such an enterprise. Meat extracts, canned meats, bone manufactures, leather, dyeing and tanning, bone manures, glue and gelatine works are only some of the lucrative aspects of this industry. In the matter of fruit farming there is room for expansion. The canning and marketing arrangements are again the points to which attention should be directed. I am told that of the fruit exported from Vancouver four-fifths comes from Washington. Canada ought surely to be able to do the whole trade! Poultry and dairy farming, organized for export trade, should also offer outlets for commercial activity. One firm in London packs shelled eggs in sealed tin cans for liners, hotels and confectionery establishments. These eggs (if memory serves aright) come from Russia. Canada could easily make this—in conjunction with milk powder and canned milk—one of her side lines.

Sugar and Alcohol

One of the German industries having an agricultural base, but being finally a chemical industry, is that of beet farming. The beets give two important products—sugar and alcohol. Great Britain has in the past depended largely on Germany for beet sugar. Why should not Canada grow beet in the eastern provinces, with an eye to this market? Alcohol, too, apart from its many commercial uses, furnishes an excellent motor fuel, and can readily be denaturised for the purpose. It gives practically the same power as petrol (or gasoline) provided the motor is designed with a view to its use, the difference consisting chiefly in the need for a higher compression. The "Autocar" states that Germany is undoubtedly running short of petrol, and that, in order to conserve its resources in this direction, a special form of carburettor has been evolved which enables all the German transport vehicles to be run on a mixture of half alcohol and half benzol. Thus, although there is no prospect at the moment of a shortage of petrol in this country, it is claimed that, having been set the example by the enemy, the War Office and the Admiralty should similarly step in here and provide funds for work to be carried out with a view to enabling England to be independent of petrol supplies for transport purposes.

In the above suggestions there may be some industries mentioned which have already had the attention of Canadian capitalists, and it should be remembered in extenuation of any such duplication that the article is written, as has been said, from the standpoint of an average London business man without the detailed knowledge available to the man on the spot. It is a well-known aphorism that "the onlooker sees most of the game," and it is possible that some of the suggestions made may be of actual service.

Intensive Industrialism

What is known as the "intensive" method of culture can be applied equally as well to industrial as it has been to horticultural work. The growth of Canada's new industries must be based on thorough scientific investigation, and the best methods of production, transport and marketing must follow. Canada, like Great Britain, can learn much from the methods of the enemy. Careful State encouragement and help have made all the difference to German industries. The German State co-operates and plans for the enlargement of the industries of its citizens. Financial arrangements are made to facilitate commerce. The banks have a strong industrial aspect. The leading German banks are identified with the various industries of the country to a much greater extent than is the case in England, and the smaller manufacturers or pioneers of new enterprises can invariably rely on financial support for their undertakings. Germany's representatives throughout the world have constituted a picked body of "intelligence officers" for Germany's commerce. The same spirit of thoroughness, method, enterprise and enthusiasm which pervaded the nation at home was shared by her representatives abroad. If "Deutschland uber Alles" has not been realized commercially it certainly has not been for want of trying

In London the feeling amongst business men is that for England, at any rate, there is need of a new spirit which can be formulated as "being in business for love of the game." A keen enthusiasm is already manifest in some circles. It will spread towards the close of the war. We shall have no use for party politicians who make the nation's commercial interests pawns in their own game, for consular representatives who represent only the diplomatic side, or for red tape and obsolete forms handed down from early Victorian days. There is a new spirit abroad—the spirit of ambition, enthusiasm and a determination to "win out."

System, Enthusiasm and Efficiency

The old unfortunate watchword "muddling through" will give place to a new motto, "system, enthusiasm and efficiency," and this spirit suffused with a warm humanity will, it is hoped, animate both the Old Country and the Colonies in their future great achievements. It is said that an American engineer who made a tour of German factories and machine shops declared that Germany was twenty years ahead of even America, where the one unpardonable sin is to fail to be "up-to-date." If this is so, it shows how we have slacked and lost ground in the past. We must make up in the future. The writer has refrained from quoting figures from blue books or white books or year books or what not. Statistics, valuable as they may be in normal times, are at the moment of less importance than psychology. If the newly awakened impulses towards scientific progress, towards closer co-ordination of effort, are wisely directed by the leaders of both Great Britain and her great Colonies, a few years will suffice to bring the Empire to a position which before the war would have been deemed impossible of achievement.

The Financing of Constructional Work

Specially Contributed by J. A. Michuard, Consulting Engineer, Montreal, Que.

SIX months have passed since the outbreak of Germany's ambitions startled the world and shook its finances. Of the many victims, perhaps the constructional industry of Canada has suffered the most. Optimism and pessimism prevail alternately regarding the immediate future of constructional development. In France we have an old saying, "Quand le batiment va, tout va." In other words, when building does well all lines of business are on a prosperous tide. If it is true, as the Bank Presidents say it is, that constructional work is to be retarded, it is certain that business in Canada will decline. The writer has no desire to prophesy hard times, but is merely stating a fundamental law common to all countries—a law from whose provisions a young country like Canada can hardly hope to be exempted.

It is not supposed for one moment that students of economics, such as the vigilant gentlemen in charge of the nation's affairs, ignore the law in question, and doubtless proper steps will be taken with a view to avoiding unnecessary national troubles. As a matter of fact, nothing appeals more to governments than the welfare of constructional lines of activity. It may be asserted safely that in this country not less than two-thirds of the entire population are dependent directly or indirectly upon constructional work. For this reason I am persuaded that money is sure to be forthcoming for engineering and building schemes. We have information from official quarters that the 1915 programme of important work will be carried out at an expense of no less than $14,000,000. The smaller items of development will remain aside for the present.

The monies for Governmental and Municipal construction are obtained from abroad, and in view of the prohibition upon gold enacted by both Great Britain and France an appreciable difficulty arises. Supposing, however, that no money is available from over the border the Government has power to deal with all emergencies, and it is easy to devise financial measures to meet requirements necessitated by the established programmes of Governments and Municipalities, without relying upon money borrowed from foreign sources. Necessity is the mother of invention the world over. When national interests call for new methods of financing, new methods must be found—providing that such innovations do not impair national credit. The Canadian people must impress this upon their Government.

Returns show an abundance of private money deposited with the banks. The greater part of the money should be put into circulation, for the simple reason that money has been created not for hoarding but for circulation through the channels of human activities. The Canadian people want that money out of the banks so as to provide for the flood of immigration which is bound to come next year or in the years to come. Of course the banks are the guardians of their shareholders' money, and banking institutions reflect the financial solidity of the Canadian people. Their responsibilities are great, and the directors have to exercise extreme caution in their decisions, which may avert or precipitate a national financial crisis at any time when acute depression prevails. The banking administration so far has been a matter for congratulation.

This, however, would appear to be the opportune time for the constructional interests to make an organized appeal for the funds held by Canadian banks. The banks are putting up no actual opposition. They ask nothing more than good solid collateral security and cash on demand if necessary. This is one of the problems which builders have to solve in order to obtain the money now in the banks. The Dominion Government is composed of men who know the value of dollars and cents, but it has always been friendly to the constructional interests. Having such encouragement in mind, all identified with construction should co-operate in organizing strong Government assistance, providing the suggestions they bring forward carry a sane conception of public financing. Instances of occasional, temporary and especial financing methods are plentiful in the history of the older countries and Canadian financiers know them well.

If, then, we assume that a grave crisis is highly probable; that plenty of money is available to prevent a crisis; that we have a willing Government, and that the banks are disposed to accommodate us, what is the solution? The solution would appear to be found in carefully-laid plans and arguments brought to bear upon the Government. The proposals, of course, should be laid before the Government by co-operative and organized interests having in view the placing of constructional activities on a working basis without the help of money coming from abroad—since none is to be had, thanks to Germany's ambitious dreams.

If constructional activities undergo a crisis this spring, two-thirds of the population will be affected severely, while all branches of trade and industry will be more or less disorganized. Such a crisis in a few short months would place the country in a state upon which it is better not to dwell. We can all imagine what a country would be like were there no work for two-thirds of its population.

Now, Canada is something more than a borrowing country; it is an immigration country. Without immigration Canada would fare very poorly, and we may rely upon it that unless we take some measures to relieve the situation of those immigrants who have been in the country only a year or two we shall lose them. We may make all kinds of excuses prompted by the war, but "empty stomachs," according to the proverb, "have no ears." If there is not some adjustment by the spring, the foreign element will soon get discouraged and we shall see a fanlike exodus. In these returning immigrants Canada will have a poor advertisement indeed. If two-thirds of Canada's actual population were reduced to a state of destitution, people would soon see Canada in another light and the reputation of the country would suffer materially.

The solution would appear to be found in organization—organization which will make sure that all the money in the country available for the purpose shall be devoted to public and private constructional work, so as to provide employment for all. Without making an honest effort to put such a policy into effect, we may as well look for long, long years of hard times. Miracles may happen, but the fundamental law of economics holds good the world over.

In conclusion, I cannot do better than quote from a speech delivered by the Hon. Sir George E. Foster, Minister of Trade and Commerce, before the members of the Toronto Board of Trade:—

"Do I say this to discourage? No! It does not discourage the brave man, the strong man, when you tell him that there are difficulties in the way, and cause him to see them. He fights all the better, and he fights all the more strongly because he has the sense of it. Now, a word at the end as to what we need. What we need is what I think we have plenty of—we need courage, and a will based on courage—courage, which has brought Canada to a position that is one of the most creditable things in Canadian progress and history. First, then let us put on courage and confidence, which are well based, and set ourselves to work to face the position and conquer it."

There is a demand for more concise and practical information regarding the economic value of the minerals contained by the province of New Brunswick. In New Brunswick there are deposits of bituminous coal, iron, limestone, gypsum, oil shale, granite, porphyry, antimony, graphite, copper, nickel, infusorial earth, etc., and yet the public at large know little of the economic value and extent of the most of these deposits. In view of the demands that the changed conditions of trade are making, practical information of this character is very desirable. If it could be furnished by the Geological Department according to provinces it would prove of inestimable value.

The University of Toronto and War

THE splendid response to the call of the Empire made by the Universities of Great Britain finds a parallel in the University of Toronto, which has made a most creditable contribution to the army from its graduates and undergraduates. In the proportion of numbers, an actual comparison could not be made to advantage, but it must be remembered that at the outbreak of the war, the military organizations of the Canadian colleges were in a much more rudimentary condition than those of the British Universities.

The following conveys an inadequate idea of what has been done by the University of Toronto, no account having been taken of the Third Contingent, but it will serve to show the degree of enthusiasm.

First Contingent

Officers.—Lt.-Col. C. H. Mitchell, B.A.Sc., member of the Board of Governors; Lt.-Col. R. D. Rudolf, Professor of Therapeutics; Lt.-Col. W. A. Scott, Associate in Surgery; Major P. Goldsmith, Demonstrator in Oto-Laryngology; Captain G. R. Philp, Demonstrator in Anatomy; Captain P. K. Menzies, Assistant in Clinical Surgery; Captain G. A. Cline, Instructor in University Schools; Captain C. E. Cole, Demonstrator in Therapeutics; Dr. B. E. Clutterbuck, Assistant in Gynaecology; Dr. A. J. Mackenzie, Demonstrator in Medicine, and Mr. E. Owen, Lecturer in German.

According to our most recent information there are, besides the members of the staff, 134 graduates and 86 undergraduates, and of these 137 are officers and 83 privates. The chief electrician and several of the laboratory assistants are also on service, and their places are being kept for them. Professor de Champ, and Messrs. Balbaud and Bibet of the Department of French in University College have been serving with the French Army since the beginning of the war.

Second Contingent

Officers.—Lt.-Col. Fotheringham, Associate-Professor of Clinical Medicine, is Chief Medical Officer. Other members of the staff who have been giving their time in preparing for its mobilisation are: Captain J. A. Amyot, Professor of Hygiene; Lt.-Col. J. A. Roberts, Demonstrator in Clinical Surgery; Lt. G. B. Strathy, Demonstrator in Clinical Medicine; Lieut. Bruce Robertson, Assistant in Pathology.

At present our information is quite incomplete, but we have the names of 53 graduates and 63 undergraduates who have been accepted.

A deputation consisting of the mayors of Calgary, Lethbridge and Medicine Hat waited recently upon Sir Robert Borden, Hon. W. J. Roche and Hon. Arthur Meighen with a request to relieving the Alberta unemployment situation. It was asked that the construction of the projected public buildings be proceeded with and also that the Government start the irrigation scheme in the Lethbridge district, the proposal being to irrigate 100,000 acres of land at a cost of $18.00 an acre, or slightly less than $2,000,000. The Premier promised consideration.

The Board of Trade of New Westminster, B.C., is urging the Dominion Government to continue the work on the Steveston jetty which is designed to maintain a deep channel across the Sandheads. To this end the executive will arrange a conference with Mr. J. D. Taylor, M.P., and formulate plans to strengthen the Dominion member's hands in this matter.

It is anticipated that a Luton, Eng., manufacturer of straw hats, who is impressed with the situation and advantages of Victoria, B.C., for a factory, will locate there.

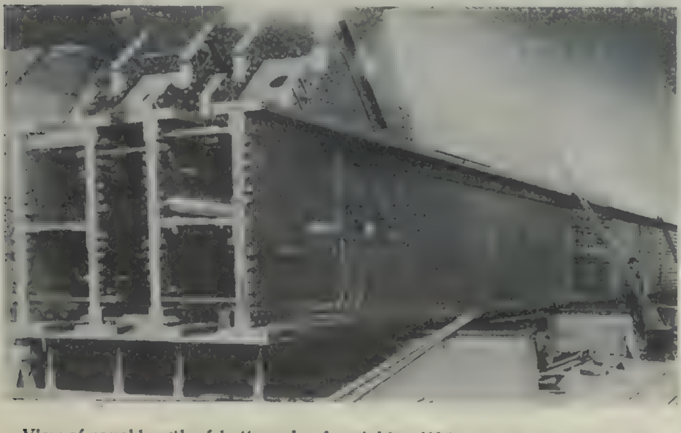
The Quebec Bridge, which has "the Longest Span Known to Bridge Construction"

Constructional Progress—How the Quebec Bridge Compares with the Celebrated Firth of Forth Bridge

Specially Contributed by H. P. Borden, Assistant to Chief Engineer, Board of Engineers, Quebec Bridge

AFTER several years' study and investigation, the new Quebec Bridge is approaching a stage where one may anticipate its ultimate completion within a short time. Work was started on the construction of the piers of this bridge in 1909, six years having been required to fully complete this work. Five piers in all were constructed—two main piers, two anchor piers, and one intermediate pier. The anchor piers, although about 150 ft. high, and containing about 17,000 cubic yards of masonry each, presented no engineering difficulties. The main piers, however, considering their volume, depth, and the conditions under which they were placed, probably constitute a record for this class of work, each pier costing in the neighborhood of one million dollars. No serious difficulty was encountered, however. One of the piers was carried down 50 ft. and the other 80 ft. below the bed of the river to solid foundations.

General view of crossing, showing start on the erection of the north anchor arm. (Note the 1000-ton traveller in operation, and duplicate being erected on the south side.)



View of panel length of bottom chord, weighing 400 tons, as now assembled in the shop.

The span of the bridge is the same as that of the old bridge, namely, 1,800 ft. This enormous length of span enables Canada to claim the honor of possessing a bridge with the longest span known to bridge construction. The justly celebrated Firth of Forth Bridge in Scotland, which up to the present has claimed this honor, has a span of 1,710 ft., but it has two spans instead of one. It might be interesting here to compare briefly a few of the features of the two bridges:

The total over-all length of the Quebec Bridge is 3,239 ft., as compared with 5,349.5 ft. for the Forth Bridge. Both bridges have two railway tracks, the Quebec Bridge having two sidewalks extra.

The Canadian bridge is designed to carry a live load per lineal foot, exclusive of its own weight, amounting to 11,000 lbs., as compared with 4,480 lbs. for the bridge in Scotland, the former weighing about 65,000 tons as compared with 57,000 tons in spite of the fact that the latter is some 2,110.5 ft. greater in length. The weight of the Quebec Bridge per lineal foot of cantilever only is 44,400 lbs., as compared with 21,360 lbs., the former having 4.03 lbs. of steel for every pound of live load, as compared with 4.77 lbs. of steel per pound of live load for the latter. The prescribed test load for the Quebec Bridge is 4 1/3 times heavier than that used for the Forth Bridge.

Thus it may be seen that while the Forth Bridge is considerably longer from abutment to abutment, yet the Quebec Bridge is not only greater in span but greatly exceeds the total weight of the Forth Bridge, due to the much heavier train loads for which it is designed.

On account of the unprecedented weight and size of members for this bridge, the St. Lawrence Bridge Company, the contractors for the superstructure, were compelled to design not only new shops, but in many cases, new and extremely heavy types of machines for the fabrication of this work. These shops have now been in operation for about two years, and at the present time have fabricated and shipped to the site about one-half the steel work required for this contract.

At the bridge site, special erection equipment also had to be provided for the handling and erection of the various members of the bridge. The heaviest piece to be handled weighed approximately one hundred tons. All equipment, both in the storage yards and in the bridge, was required to have a capacity of this amount.

The erection traveller required for the erection of the cantilever bridge proper is a very elaborate piece of equipment, weighing in the neighborhood of 1,000 tons, standing 200 ft. high, and costing about $175,000. This traveller is equipped with two travelling cranes running on tracks at the top, and also with four hoisting engines for operating booms at the four corners of the tower. All the machines on this traveller are operated by electricity, and most of them are controlled by one man at a control board on the lower bridge. This man is thus enabled to be at the lower level—where most of the work is going on—and can take his instructions directly from the foreman in charge.

During the past season very satisfactory progress has been made in the erection of the North Anchor Arm, practically the whole of this part of the bridge, amounting to some 15,000 tons, having been completely erected in place. This part of the structure is erected on elaborate steel falsework supporting the floor upon which the erection traveller runs and also supporting the trusses independently of the floor. This falsework is fitted with pneumatic jacks at the base, by which it can be adjusted to suit required conditions during erection. Owing to the limited capacity of the handling apparatus, as determined by practical considerations, practically all members of the bridge are shipped in two halves and spliced longitudinally in the field after erection. Instead of the pins at the panel points being continuous through all four webs, they are made in two halves, each half taking the stress from two webs only. This applies in all cases, with the exception of a few minor tension members. Thus it will be seen that each truss of this bridge is in fact two distinct trusses, with separate pins placed side by side and connected in the field with diaphragms and lattice bracing.

Construction of the north anchor arm.

Another departure from ordinary practice is noted in the top chords, where the eyebars between main panel points are supported at the centre on small lattice trusses. This does away with the necessity of providing a redundant member at the middle of the panel to support the eyebars during erection.

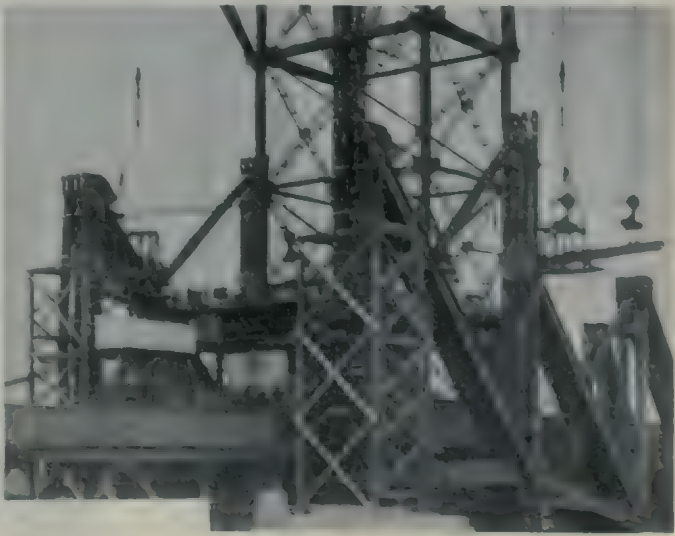
Next spring the first thing to be done will be the erection of the main posts over the shoe on the main pier. These posts are probably the largest members ever manufactured, being 310 ft. long, centre to centre of pins, supported laterally at only one point during their entire length. The cross sections of these posts are really four separate box columns, one at each corner, being tied together by plates and lattice.

Enormous proportions of details of compression member where seven members intersect

One of the most complicated details of the bridge is the link at the extreme top of this post, which is all nickel steel, and the point of intersection of seven members. This detail has webs 7¾ inches thick, and weighs approximately 140 tons. The four posts required for this bridge will cost, erected, in the neighborhood of one million dollars.

Steps are now being taken to erect a duplicate traveller and falsework on the south side of the river, and next year work will go on simultaneously on both sides of the river.

By the end of next season it is hoped that the north cantilever arm and south anchor arm will be fully erected. By the season of 1916 it is expected that the work of erecting the suspended span will be undertaken. This span, 640 ft. long, 110 ft. high, 88 ft. wide, and weighing about 5,500 tons, will be floated into place instead of being erected as a cantilever from the end of the cantilever arm. By this scheme of erection about one year will be saved in the erection of the bridge. It is expected that this span will be erected on the shore at some point in close proximity to the bridge site, and that at the proper time it will be transferred to large pontoons and floated into position. It will be lifted off the pontoons by means of heavy steel hangers at the ends of the cantilever arm and hoisted into position by means of powerful hydraulic jacks. From the fact that at this point there is



Heavy member of the truss in course of erection.

about a 16-ft. tide and an 8 to 10-mile current, the erection problem is rendered both interesting and difficult.

It is expected that the bridge will be open to traffic early in 1917.

The construction of this bridge is under the direction of the Board of Engineers of the Quebec Bridge, which is composed of Messrs. C. N. Monserrat (Chairman and Chief Engineer), Ralph Modjeski, and C. C. Schneider.

Why Canada Should be Optimistic

By W. J. Whiteside, Toronto

EVERY optimist in Canada should take a pessimist in charge. The cheerful man should gently lead the disciple of calamity to some quiet corner, and there impart to him as kindly as only the true optimist can, the knowledge that this country will still be distinctly visible on any good map of the world when peace is concluded in Berlin. The pessimist is not a thinker and his imagination flourishes only in grooves of gloom. It is necessary that he be trained to walk upright in the sunshine among the people who are adapting themselves to new conditions before he can be expected to shake off his adopted convictions and take his proper place in the daily toil of the nation. The national machinery in this country did not stop when the first German goose-stepped across the borders of Belgium. Canadians did not take to their cellars or cease to eat as usual. Neither did the products of the fertile fields of Canada disappear from the bins and the elevators or the live-stock perish on the hillsides. Few manufacturing plants of consequence had to close because of the inauguration of hostilities and those that did will be started again before long. Admittedly, the war has disturbed business, but not beyond the possibility of rapid and efficient adjustment, and those adjustments have in large measure been already achieved. As the first shock is always the hardest to bear, it is reasonably safe to assume that the problems of the future will be as capably handled and that day by day the nation will progress to a position of steadiness and contentment.

There were not lacking pessimistic prophets to preach that dark days were dawning when Canada's volunteers began to gather for service over-seas. Yet, because of that mobilization, factories throughout the country were soon running with full staffs, and, in many cases, running overtime, to furnish the equipment required. Boots, socks, underclothing, uniforms, rations, rifles and ammunition had to be acquired. As the Government has announced that men will be constantly in training here while the war lasts, it is likely that these self-same factories will continue to operate, as a result of the war, while the conflict lasts. In addition, quite out of a clear sky, came orders for saddles and harness from the Governments of Great Britain, France and Russia, in large quantities because the manufacturing plants of those countries could not produce the supplies needed quickly enough. The harness business is always rather dull in the fall and the demands of the armies of the allies were gratefully received. Canada is being called upon to furnish horses at good prices, beef at good prices, and other foodstuffs at good prices, and in bulk considerably greater than is customary in times of peace, so that Canada's portion of the war surely has not been an unmitigated evil.

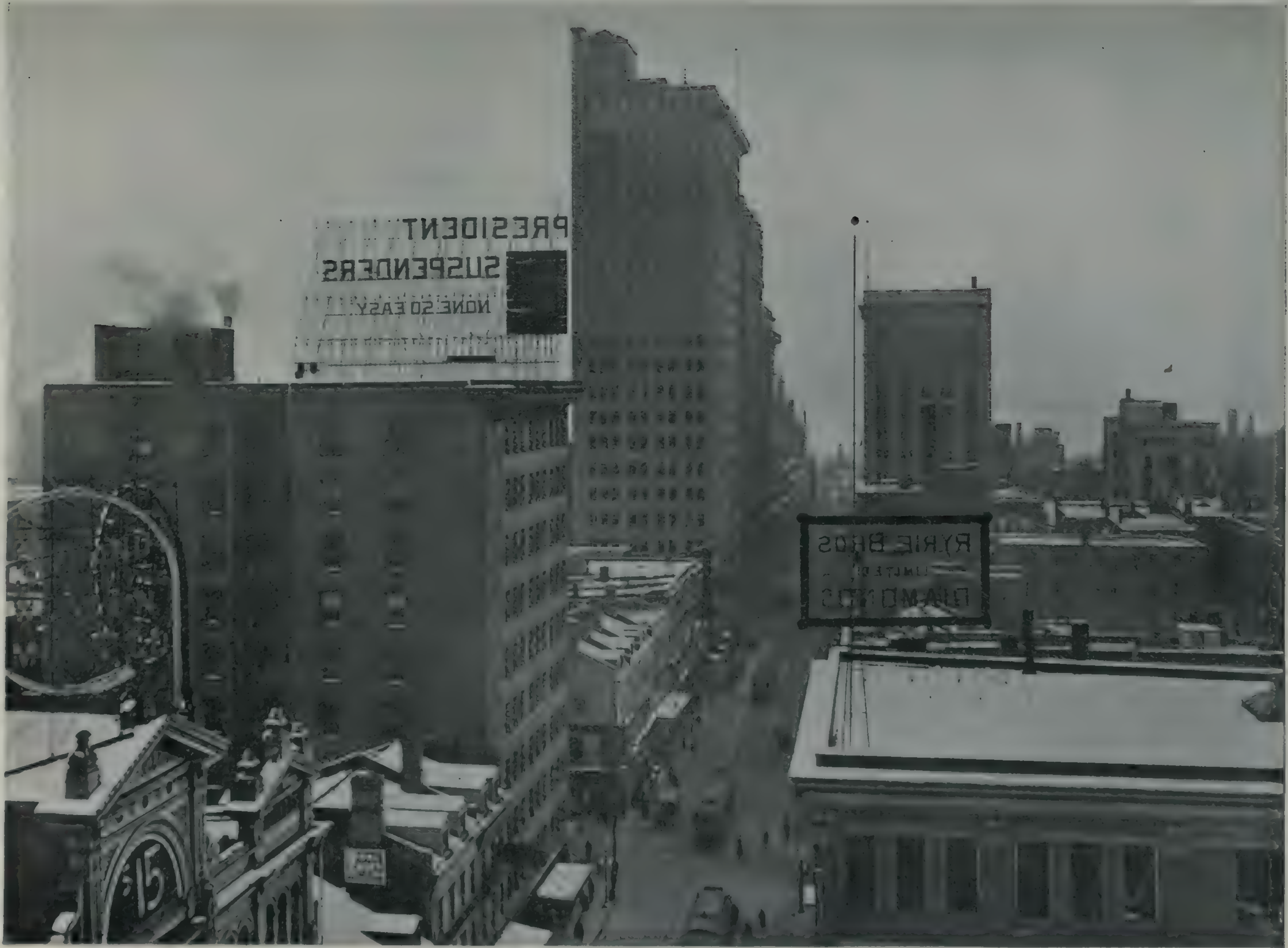
The markets of a few manufacturers were upset by the Old World fighting, but they will find that their products may be diverted to other markets. As a matter of fact producers so placed are not numerous in Canada. The majority of our manufacturing plants are devoted to the production of goods essential to the daily routine of the people and the demand in the home market is sufficient to enable them to maintain operations.

The last Dominion census, that of 1911, is authority for thestatement that there were in Canada, in 1910, some nineteen thousand odd manufacturing plants. Of those, 6,985, or more than a third of the manufacturing plants of the Dominion—were devoted to the production of foodstuffs. As the people have to be fed, most of these plants should be able to carry on their operations as usual. The employees on the pay rolls of these factories in 1910 numbered 52,730. The wages paid totalled $14,492,568, and the cost of materials stood at $175,453,469, the whole constituting a considerable item, the spending of which is calculated to stimulate activity in other lines of industry.

In timber and wood products the census gives the number of plants as 4,999, employees 110,049, the wages paid $39,379,739 and the cost of materials $94,052,429. Speculative building has largely ceased, but Canadian woods may be an essential feature of specifications for buildings going up for the Governments and for municipalities throughout the Dominion. There will possibly be a decrease of output in furniture. The lumber mills ordinarily enjoying an export business ought to be able to continue operations much as usual, though they will not have access to Germany and Austria, and there is ample opportunity for many of the other lumber men to seek outside trade as well.

The textile industry appears to be in an excellent position. The number of plants in 1910 is given as 1,444, the 72,672 employees were paid $26,703,826 in wages, and the cost of materials was $72,128,436. With the cutting off of supplies from Germany and Austria our Canadian plants should be called upon to furnish a wider range of goods than ever before for the domestic market, and what with the making of necessary clothing these factories are busy. It rests with the manufacturers themselves whether they are to hold the new domestic market when the war is over and trade routes are open all over the world.

In paper and printing the statistics show 773 plants. Employees numbering 22,894 received in wages $10,866,721 and the cost of materials was $16,956,697. As the newspapers, to give the news of the war are going to issue more often than in times of peace, it stands to reason that men will continue to be employed cutting the spruce in the woods, floating it down the rivers or loading it upon trains for delivery to the mills, and that the pulp and paper plants will keep on with the business of turning out paper at least in quantities as plentiful as in peaceful days. For cardboard and papers other than that used by newspapers there is still a demand. At present there may be a slight



The Growth of an Empire Centre.—Toronto's consistent growth during the last ten or fifteen years is even more remarkable than the spectacular performances of some of the Western cities. During the last decade the population of the city has increased from 227,000 to 470,000. There is no more imperial-thinking or rather imperial-acting, city in the British Empire than Toronto. Ten thousand of her sons are now in arms or in training for the cause of the Empire. The above view is from a recent photograph of Toronto's main thoroughfare, Yonge Street.

The Day

(From a poem by Henry Chappell, a railway porter of Bath, Eng.)

You spied for the Day, you lied for the Day,
And woke the Day's red spleen.
Monster, who asked God's aid Divine,
Then strewed His seas with the ghastly mine;
Not all the waters of all the Rhine
Can wash your foul hands clean.

You dreamed for the Day, you schemed for the Day;
Watch how the Day will go.
Slayer of age and youth and prime—
Defenceless slain for never a crime,
Thou art steeped in blood as a hog in slime,
False friend and cowardly foe.

But after the Day there's a price to pay
For the sleepers under the sod;
And Him you have mocked for many a day—
Listen, and hear what He has to say:
"Vengeance is Mine, I will Repay,"
What can you say to God?

falling off in the amount of printed matter demanded by the manufacturers, wholesalers, and retailers, so that the job printing plants and the advertising columns are not called upon as frequently. But that condition is passing.

Chemistry has been described as the intelligence department of industry. The making of chemicals and allied products in Canada in 1910 required 178 plants and 5,274 employees. The wages paid amounted to $2,393,971, and the materials involved cost of $14,059,022. There have been no reasons cited why Canadians could not take up this industry more systematically matically and become independent of outside supplies. We have arsenia, antimony, cobalt platinum, nickel, copper, silver, gold, phosphates, asbestos, coal, iron and tungsten among other things listed as natural resources. **Yet the bulk of our refining is carried on outside the country. The chemical industry in Canada now has a splendid chance to make history.**

The Canadian iron and steel industry is only in its infancy. Perhaps it is just as well that such is the case because otherwise the army of unemployed would certainly have recruited from the big plants. Federal statisticians numbered the iron and steel shops in 1910 at 824, employees 48,558, wages paid $25,792,388, and cost of materials $52,452,103. The industry is most prosperous when countries are doing a great deal of new construction, when the skeletons of big office buildings are etched against the sky, and confidence is rampant in individuals. But a pleasing feature is that orders for this class of work are placed usually a long way ahead. Then, too, the Federal Government proposes to go on with a vast amount of construction work, and provincial governments and municipalities, as far as they are able, will proceed with similar enterprises.

The leather goods trade has already been touched upon. It is bigger probably than most Canadians imagine, the Ottawa officials giving the number of plants in 1910 as 399, the number of employees 22,742, the wages paid $9,644,403, and the cost of materials, $34,394,189.

The clay, glass and stone products are produced in 771 plants by 17,699 employees, the pay roll amounting to $7,745,342. It is in much the same position as the iron and steel industry, being concerned mostly with building. But this should provide an excellent opportunity for makers of brick, stone and cement to stock up in order that they may be in a better position to make prompt deliveries when the demand starts in earnest again.

These are our chief industries. They total to 16,373, or within 2,845 of all the factories enumerated by the census man in 1911. The employees number 352,618. They are concerned with the making of essential products. The people need the goods they manufacture. Today, even after all the prophecies and calculations unemployment has not increased anything like the proportions expected when the war began. It is unlikely that it will, and there will be the added solace that this year, because extraordinary conditions prevail, legislative aids will be provided which were never available before.

As for the manufacturers, they are following the advice of Sir George Foster, and are studying the position from every standpoint. Up to the commencement of hostilities we had been importing from other countries more than $600,000,000 worth of goods a year, the goods coming in large measure from the United Kingdom, the United States and from Germany and Austria-Hundary imports to the value of $350,000,000 a year. The German and Austrian trade to Australia, New Zealand, South Africa, India and other British Dominions was quite considerable. Without going any further there is nearly a billion dollars in trade open for competition. Some of it ought to be secured by Canadian manufacturers. Great Britain is sympathetic; so is Australia; so is New Zealand. If our people are in earnest, now is the time for manufacturing ability and capital to get together and work the problem out.

The Workmen's Compensation Commission of the Province of Ontario, Canada, judging from its insurance rates, is taking no chances, comments Engineering and Contracting, editorially. It has fixed the assessment for workers engaged in steel construction on high buildings at $7 per $100 of wages paid. This is an increase of $2.28 over the rates of liability insurance companies on similar work. The Commission's rates, for shop work are $2 per $100 of wages, as compared with liability company insurance of 42 cents per $100. This increase in rates is rather a serious matter to the larger structural steel construction companies. They, however, have entered no protest, owing to the assurance of the commission that there will be a readjustment of rates based on the first year's experience.

The British War Office approves of "made-in-Canada" goods, according to the following Canadian Press despatch, dated January 12th:—

"William L. Griffith, Secretary to the Lord High Commissioner in London, says in a statement to the press regarding the British purchases of war equipment in Canada:—

"In the past few weeks British orders placed in the Dominion have amounted to between $25,000,000 and $30,000,000. The French and Russians have also placed large orders in Canada."

A Brief Discussion of England's Proposed "Board of Industry"

Specially Contributed by the London, Eng., Correspondent of the Contract Record

IN England there is a movement on foot for the formation of a "Board of Industry." There is of course, a very miscellaneous collection of "movements" afoot now, the great proportion of which are run by interested parties, and it is possible that the proposed Board may fall within the same category. Patriotism is a potent lever for both good and ill, and the truest patriot is possibly he whose voice is unheard. Still the proposal to form a "Board of Industry" is an interesting one, and even if the appointments which may be made are conferred upon the parties who have run the show it does not necessarily prove that these same parties would not have worked with quite as much ardour had plums been out of consideration.

Constitution of the Board

It is proposed that the Board be constituted as follows: President—Man of great business ability, permanently in office and preferably to be elected a member of the Cabinet. Council—15 leading men of business ability, representing the industries of Agriculture, Banking, Building Materials, Chemicals, Cutlery, Electricity, Engineering, Foodstuffs, Hardware, Iron and Steel, Leather, Paper, Railways, Shipping and Textiles. Also one representative each of the Indian Empire, and the self-governing Domonions of Canada, Newfoundland, Australia, Union of South Africa and New Zealand (preferably the High Commissioners, or their nominees), and three representatives of the Crown Colonies. Trade Commissioners—with staff and trade correspondents, as may be required, in India, each self-governing Dominion, Crown Colony and foreign country, with wide experience of trade conditions and requirements of the territory in which they operate. Additional to these there would be a parliamentary secretary, permanent secretaries, and a full staff of clerks who have had a business training.

The Foreign Office

Now, if some such body could be formed it would be of inestimable value in promoting the commercial interests of the Empire. These interests depend now almost entirely upon individual efforts, since neither the Board of Trade nor the Foreign Office is of much use to the trading community. The commercial attache to the Foreign Office staff is a man who is obviously so named because he is without knowledge of commerce. Diplomacy is his sole aim and end, since the better paid posts are all in the Department which is at the best a real danger to the nation. Speaking on this question of Foreign Office support, Mr. Wilfrid Stokes (who has written a pamphlet around the Board of Industry proposal), says: "As to numbers, it is only necessary to give China as an example. This country, with vast openings for trade with Great Britain, has one commercial attache to cope with British trade questions arising from a population of 400,000,000, and an import trade of over £80,000,000 annually. An example of how the Foreign Office is hampered by want of funds is furnished by the following:—Quite recently the only two daily papers printed in English in Peking have been bought up by Germany, obviously for the purpose of misleading the Chinese by news purporting to come from English sources and therefore presumably true. Much as the Foreign Office regrets this attack by Germany, nothing can be done as no funds are available. Could anything be more deplorable?"

The Board of "Trade"

"Turning to the Board of Trade," continues Mr. Stokes, "there is in London a well-managed Commercial Intelligence Department which is doing its best under adverse circumstances. It publishes a Journal and issues reports received via the Foreign Office and the Board of Trade from British consuls, many of whom are unpaid, some of whom are of alien nationality, and all of whom have many other more pressing duties. There are in addition a small number of not too well paid trade commissioners with their trade correspondents, who, although keen and capable, are unable to do much more than pick up information from friends and others whose interests in no way encourage them to give prompt and useful information. Thus these reports are not in many cases of much practical value. A small sum (about £500) is annually spent by the Board of Trade on special trade research work in various countries. As to the Board of Trade itself, its functions are much too general. Its constitution was never intended to apply to the furtherance of foreign trade, thus it is not suited for that purpose and, as at present constituted, never can be. It may almost be said that its principal functions involve the hindrance of trade by imposing rules and restrictions, good in themselves, but often, owing to the lack of special special knowledge, framed so as to cause unnecessary difficulties in carrying them out." Last year the amount of our foreign trade was over £1,400,000,000, yet the cost of running the whole of the Board of Trade, including all the home departments, was only about £213,000, or say 3½d. per £100 of the trade done. Well may it be asked: what private business trading with foreign countries could hope to prosper with such a trifling expenditure for general supervision and exploitation from headquarters?

Political Appointments

It has been said above "if some such body could be found," and here is the crux of the whole matter. Recent appointments, such as those in connection with the Road Board (referred to more than once in the columns of the Contract Record), prove plainly that it is almost too much to expect any Government to act in honest, business-like fashion. The average appointment is a "job," and as, in years past, the reward of, say, excellence in poetry was an appointment as gauger in the Customs, so now a man who excels in the boiling and vending (in a wholesale way, of course) of sheep's trotters, or in the running of a huge general shop (euphemistically termed a "store"), or the monopolising of the railway bookstalls, may have almost any post he likes politically to work for. The formation of a Board of Industry would almost inevitably mean bombardment in high places by a horde of hungry office seekers. The softer sex, too would set to work string-pulling, and callow youths fresh from universities, via Harrow and Eton, would monopolise all the posts worth having. Being a business Board our trotter-vending, general shopkeeping and paper-selling friends would have no show, simply because they do know something of business.

A Practical First-Step

This is a gloomy view to take of the matter, however, and one must hope for better things. The war will not have been without its lessons, and it will not have been fought quite in vain, if it kills the party system of Government. With the decease of the party system, cleanliness will enter into politics, and cleaner methods must spell at least the partial overthrow of jobbery and nepotism. Anything like a Board of Industry must be beyond suspicion. On the national trade depends the national life, and politicians should no longer be permitted to play with it as with a shuttlecock. Successful trading calls for the co-operation of the manufacturer, the salesman and the capitalist, all three of whom should be encouraged by the country, and the necessity for this is accentuated when the question on the board is international or at least intercolonial trading. There is no need to harp upon what Germany has done. The subject has been talked under the table months ago now. But we have learned some useful lessons from her, and it is essential that we profit by them. The establishment of a Board of Industry, with men of integrity and business ability to boss and to run the concern, would be a very practical first step.

* * *

Since writing the above, the Fifth Report of the Royal Commission on the Civil Service has been issued, and the following extracts are made solely because they prove the correctness of the writer's statements. Speaking of the Diplomatic Service, the report says that this is effectually closed to all His Majesty's subjects, **be they ever so well qualified for it,** who are not possessed of private means. The official conditions of entry fix the amount of the private means required at a minimum of £400 a year. "The effect," proceeds the report, "is to limit candidature to a narrow circle of society. We have been furnished by the Civil Service Commissioners with the educational antecedents of the successful competitors for attache-ships in the years 1908-13 inclusive. No fewer than 25 out of 37 (about 67 per cent.) came from Eton, while all but a very small fraction had been educated at one or other of the more expensive public schools. In only one case was any university other than Oxford or Cambridge represented. With a view to widening the area of selection, as well as on more generous grounds, we recommend that in future the salaries and allowances in the Diplomatic Service should be so adjusted as to make it possible for a member of that service to live upon his official emoluments. We desire to express our surprise that the existing arrangements should have been tolerated so long." This expression of surprise from men who must have known how the ropes are pulled is distinctly humorous.

There are some commission brokers in New York who are in a rather awkward fix owing to the war. The plight they are in is described by the New York Commercial, which says that they have on their hands about $3,000,000 worth of goods made in the United States intended for the South American trade, and of those goods they cannot ship a dollar's worth because they are all stamped "Made in Germany." If they are shipped they are liable to seizure by British ships. The situation reveals what is called "a sharp Yankee trick," which in the end did not prove sharp at all. German trade has a pretty good hold in Brazil and other South American countries, and these Americans found that by the simple method of stamping "Made in Germany" on the goods they handled they could greatly increase their sales. It was easy. But now they have $3,000,000 worth of goods which they can't ship—and no market has been made for their own goods minus that bogus stamp.

Unsavory Government Procedure

Commenting on the state of suspended animation in which the architectural competition for the new public buildings at Ottawa is found, "The Builder" (London) states that the Canadian Government authorities do not seem to have thought it necessary to keep faith with those architects who were asked to submit designs. It will be remembered that the competition was a double-barrelled one, and that Mr. T. E. Collcutt was appointed assessor. Following the outbreak of the war, it was decided to postpone the carrying out of the scheme. Objection could not be reasonably taken to the decision, but there is no reason why the competition should not have been carried through as originally intended, and the premiums awarded. Now, on the abandonment of the final competition, it appears that the designs selected in the first competition have been publicly exhibited. This is a breach of public faith. The anonymity of the schemes which were to form the basis of their authors' final designs is destroyed, and the secrecy as to the exact nature of each scheme is ended. Such action is not calculated to encourage the participation of prominent architects in competitive work.

Mr. W. G. Davis, an Ottawa architect, furnishes us with a statement in reply to our request for his opinion on the outlook for 1915: "It is only natural at such a time as this," he writes, "that speculative building should be retarded by the general timidity and unfavorable financial conditions brought about by the European war. In this locality there are still large works awaiting completion—undertakings which have been held up by the war and by money difficulties. Until these works are finished, new projects will be scarce. The work now under way is primarily that which ranks as necessary, and secondarily that which has been induced by the lower cost of labor and materials. Generally, of course, conditions are not what they were this time last year, but I am optimistic enough to think that 1915 may have much in store for us all."

The Parliamentary estimates for 1915 provide for an expenditure of roughly $150,000,000, of which $106,000,000 is on consolidated fund account and $44,000,000 on capital account. The funds for constructional work include—Quebec Bridge, $3,500,000; Welland Canal, $5,500,000; railways to connect Montreal with N. T. R., $750,000; Trent Canal, $1,500,000; Toronto harbor improvements, $1,000,000; Port Arthur and Fort William harbor, $1,200,000. Important revotes are: new Dominion buildings, Toronto, $225,000; Toronto military buildings, $213,000; Spadina Avenue (Toronto) postal station, $74,000; French River improvements, $45,000.

The Legislature of Quebec proposes to raise another ten million dollars to be used for improvements of roads throughout the province, this being an addition to a like amount passed in 1912.

Sir Thomas Shaughnessy—Railway President and Empire-Builder

THE material development of Canada during the last few years is due to many causes, and certainly the growth of the railway systems has been one of the most potent factors in building up this portion of the Empire. The C. P. R. can claim to have done its share in this work, and its expansion may be fairly stated to be owing, to a large extent, to the activity and foresight of Sir Thomas Shaughnessy, K. C. V. O., the president. For more than thirty years Sir Thomas has been identified with the company, which by its enterprise has opened up immense tracts of territory and allowed hundreds of thousands to settle on the fertile plains of the West.

Sir Thomas Shaughnessy was born in Milwaukee on October 6, 1853, and began his railway career at the age of sixteen. In October, 1881, he was appointed Purchasing Agent of the C. P. R., which shortly before had been handed over to a syndicate to complete. His ability in the Purchasing Department soon led to promotion, and after occupying various positions he was appointed vice-president. This was in 1891. Eight years later, Sir William Van Horne, the President, retired, and Mr. T. G. Shaughnessy was elected his successor. In 1901 Mr. Shaughnessy received the honor of knighthood, and in 1907 was raised to the rank of Knight Commander of the Victorian Order—honors due to the man who has presided over a company which, to use the words of the King, "has helped to make a nation." Practically the entire life of Sir Thomas has been devoted to the interests of the C. P. R., and its later developments have been the result, in a great measure, of his initiative.

Sir Thomas Shaughnessy, K.C.V.O.

The keynote of the policy of the President may be thus summed up: First, to inspire confidence in the money markets of the world by economical management; by the publication of accurate information as to the earnings and financial position of the company at all times; by providing substantial returns on their investments to the stockholders; by a programme of vigorous expansion, indicating optimism and faith in the country of Canada; second, to carry on extensive propaganda in over-populated countries, so as to encourage immigration into Canada's undeveloped lands and increase the population tributary to the C. P. R.; third, to facilitate the settlement of practical farmers on Canadian Pacific lands and encourage the best farming methods; fourth, to encourage industries, the development of mines, and the establishment of factories along the line, not only with the object of providing employment for skilled and unskilled labor, but also to increase the markets for increased agricultural production and develop the natural resources of Canada; fifth, to strive for harmonious relations between employees and employer; sixth, to provide prompt and efficient service to passengers and shippers.

The Canadian Pacific is something more than a railway company. It has branched out into enterprises which are not usually within the province of such companies, and although the expenditure was no doubt in the interests of the shareholders, none the less the result has been of immense benefit to the country. To use the words of the Times, "There is a general feeling that the company, as represented by its President and Board, is a strong fortress of national and Imperial sentiment. No other enterprise has done so much to establish and maintain the credit of Canada. It has assisted materially in settling the western provinces; it was active in attracting immigration when the Government services were inactive and inefficient; it has kept trade within Canadian channels and developed ports on the Atlantic and on the Pacific; it has improved steamship communication with Great Britain and with the Australasian communities."

Sir Thomas does not confine his activities to the C. P. R. He takes more than a passing interest in public, and in a minor degree in local, affairs, outside of mere party questions. Movements for the public welfare find in him an ardent supporter, while he is also an occasional speaker at meetings such as the Canadian Club lunches, where matters of permanent and temporary importance are discussed. He is particularly interested in questions with an Imperial aspect, and his speeches are inspired by a broad view of the responsibilities and duties of Canada as a member of the British Empire. In these days, with the country in the midst of a severe set-back, there is an inclination to be pessimistic. The President of the C. P. R., however, declines to subscribe to the views of those who look on the dark side of the picture, and he is on record as a firm believer in the future of Canada and in the development of its fine natural resources, to which the C. P. R. has materially contributed. To quote his own words used last year, "The remarkable progress of Canada and the C. P. R. will be continued with an impetus all the more vigorous because of the recent breathing space."

The manufacturers of Waterloo County, Ontario, through their Boards of Trade, are investigating the possibilities of securing some of the export trade which formerly belonged to Germany and Austria.

Patents and Trade Marks as Affected by the War in Europe

Specially Contributed by H. J. S. Dennison, Patent Attorney, Toronto

MANUFACTURERS, dealers and contractors operating in various spheres of constructional work are aware that many valuable inventions are being wrought out from time to time by men active in the various arts. The principal aim is increased efficiency and saving in cost of both labor and material, and much valuable time and thought, as well as money, is expended in bringing these improvements to greater perfection.

Careful business men realize the importance of retaining the advantages accruing from such developments, and take advantage of the privileges afforded under the Patent and Trade Mark laws.

The economic conditions brought about by the war are such that many foreign inventors holding patent rights find it practically impossible for them to carry their inventions into commercial effect in Canada, as well as in Great Britain, and "The War Measures Act of 1914" was passed by Parliament to enable the practical carrying out of useful inventions which might otherwise be lost to the public benefit.

Enemy Patents Not Common Property

Much misapprehension, however, has been spread regarding the intention of the "Act," and unfortunately a belief has spread broadcast that patents of alien enemies were confiscated and consequently thrown open for common use. It must be understood that this is not the case, as great care has been taken in Great Britain that no person is permitted to make a patented article when an enemy is the owner, nor is a license granted to anyone until full investigation of the conditions has been made, and both the applicant for a license and the representative of the patentee have been heard.

So far, few licenses have been granted in Canada under this Act, but in Great Britain, from whom Canada will probably take the cue, licenses have been given stipulating a reasonable royalty to be paid to a Public Trustee, presumably for the benefit of the patentee after the war is over and international argreements have been satisfactorily adjusted.

It must not be assumed, however, that there will be no particular advantage to anyone seeking a license under such conditions; on the contrary, the intention is to encourage the manufacture and use of these inventions, and ample protection will be afforded those bringing into active service inventions which might otherwise be lost, and the conditions will undoubtedly be such as to afford a continuity of the enjoyment of a license given. Neither will licenses be granted broadcast so as to reduce the interest of parties putting down plant or taking expensive steps to bring the invention to the public.

Requirements of Applicant

The Order in Council provides that a person applying for a license must satisy the Commissioner of Patents on the following heads: (a) that the holder of the patent is a subject of a state at war with His Majesty; (b) that the applicant intends to effect the manufacture of the patented article or carry on the patented process; (c) that it is in the interests of the public or a section thereof that the patented article be made or the proces scarried on.

Many valuable patents have been granted in Canada to Germans and Austro-Hungarians, and it is well known that the electrical, mechanical and structural arts are developed to a very great extent in these countries, consequently the advances made may be taken full advantage of by enterprising manufacturers here.

Canada, while being at war, has the peculiar advantage of not being in the war area. Much has been said and written of the possibilities of trade expansion, and many valuable patents owned by Germans or Austro-Hungarians in the United States may lie dormant for a considerable period. Canadian manufacturers, however, may avail themselves of the peculiar conditions existing, and looking to a larger market, may expand their export trade not only to the United States but to the many other countries which are now cut off from Austria and Germany, particularly in the South and Central Americas.

The United States merchants and manufacturers are alive to the opportunities of the establishment of export connections, as evidenced by a large gathering of over one thousand leading representatives of American industries in New York City, held recently for the purpose of enlarging these connections. Why not Canada? Figures gathered for this meeting show that 86 per cent. of the total import trade of these countries has been carried on with Europe. The import trade of South America alone is approximately one billion dollars per annum, and now that war has supplanted industry in the countries of Europe supplying most of this trade, the exports from Europe are practically at a standstill.

The really great markets of the present and future in South America are Brazil and Argentina, the former being greater in area than the United States and having a capital, Buenos Ayres, with about three million of a population. The countries of the west coast—Columbia, Ecuador, Peru and Chili—are now, since the opening of the Panama Canal, brought much closer.

In all of these countries much constructional and development work is being carried out, and consequently the dormant state of European manufacture leaves a great field open for those who will take advantage of the situation. Increased production for export will do much for the development of Canada, which, with its great resources, will be a natural outlet for much European capital after the war.

Canada has seen a wonderful period of growth. and has ample room to expand. While home markets in various lines are limited, the industries represented can be greatly expanded by export trade, which must redound to the benefit of the country; and it must be borne in mind that these large countries to the south, with their immense populations, are acquiring more and more the advanced conditions in civil engineering and building construction lines.

A transformer station mounted on a wagon is being used in connection with electrically-driven centrifugal pumps to unwater sewer trenches at Salt Lake City. The contract, which was let to the Ulen Contracting Company, called for about seventy miles of trench work, most of which is in water-bearing soil. The primary circuits of the Utah Light & Traction Company can be tapped within three blocks of any of the trenches to be pumped. The wagon transformer station is connected to the nearest point on this circuit, and portable cables as long as 2,000 ft. are run from it to the pumps. The pumps are operated by 5-h.p. motors, and from six to ten may be run at a time from the one transformer station.

Lord Cowdray—A Brief Sketch of the Famous Contractor and Oil Magnate

(London Staff Article)

It is given to few men to see their life work reach its fruition so completely as has been the case with the subject of this sketch. As the head of the famous firm of contractors, Messrs. S. Pearson & Son, Limited, he attained a distinguished position in the engineering and contracting world, while in more recent years he has become the controlling genius of the greatest British oil company—one which for magnitude and influence ranks practically on equal terms with the great American and Royal Dutch interests.

The story of the work which has produced such results must necessarily be of an interesting and to some extent of a romantic character, though there is little savouring of romance in the personality of Lord Cowdray, as witness the impressions of Mr. T. P. O'Connor, M.P., in his article which, in 1913, appeared in the Pall Mall Magazine. Said T. P.: "You could not mistake him for anything but a Yorkshireman. The robust frame—the cold self-controlled voice and manner, the deliberate and terse speech, and a suggestion of grim and yet genial strength—they are all typical of that remarkable race. And when he begins to talk you feel still the atmosphere of Yorkshire. Though it be of gigantic affairs he is speaking, it is but as though he were discussing the time of day. You cannot imagine him as ever anything but the calm, terse, self-controlled, quietly and good humoredly self-confident man whom an earthquake would leave undisturbed."

Lord Cowdray.

Lord Cowdray, who is perhaps better known in engineering circles as Sir Weetman Dickinson Pearson, Bart., was born near Huddersfield, Yorks, in 1856, and was educated at a private school near Harrogate. At the age of 16, he embarked on the career destined to become so notable, joining the contracting business started by his grandfather, the late Mr. Samuel Pearson, in 1844. In 1879 Mr. Weetman Pearson became partner in the firm, which in 1897 was converted into a private limited liability company with a capital of £1,500,000, the directorate consisting of Lord Cowdray and Sir Clarendon Hyde. In more recent years Lord Murray of Elibank became identified with the firm. In 1894, the subject of our sketch received his baronetcy, and he was made a peer in 1911. In 1881 he married the daughter of the late Sir John Cass, of Maylands, Yorkshire. His eldest son, the Hon. Harold Pearson, who married a daughter of Lady Spencer Churchill, is M.P. for the Eye Division of Suffolk, and his daughter is the wife of Lord Denman, who was until last year Governor-General of Australia.

Turning to the list of important contracts carried out by the firm the necessity is at once realized of selecting only a few typical examples. In the "Contracting World Directory" two and a half columns of these contracts are given, from which we select the following:—Sewage outfall works at Southport, Ipswich, and Deptford were quickly followed by the construction of the Bentinck Dock at King's Lynn and the capacious docks at Milford. Three years later the Pearson firm were at Southampton where they built the deep-water Empress dock, while the year before they had completed a graving dock of large dimensions at Halifax, Nova Scotia, which has been of considerable service to the British and American Navies. At the same time the firm were engaged upon the Mexico Drainage Canal, 47 kilometres long, and involving the removal of some 18,000,000 cubic yards of excavation. Other large contracts followed in quick succession, including the doubling of the Great Western Railway Company's main line through South Devon, dredging work at Alexandria Harbor and in Bermuda, the construction of the Avila and Balamanca Railway in Spain, the completion of the tunnel under the Hudson River at New York, and the four tunnels under the East River for the Pennsylvania Railway. In 1892 they commenced the famous tunnel under the Thames at Blackwall the contract price of which amounted to £870,000, and in May, 1897, it was opened to traffic by the late King Edward VII.

Among other works carried out were the Cardiff Channel Graving Dock, Port Talbot Docks and Railways, Hull Joint Graving Dock, Plymouth Main Drainage, Lambourn Valley Railway, Vera Cruz Harbor, Great Northern & City Tube Railway, the two magnificent harbors at Puerto, Mexico, and Salina Cruz which connect the Atlantic and Pacific Oceans by the Tehuantepec Railways, the South Wales and Bristol Direct Railway and the famous Admiralty Harbor at Dover, the last-named costing between 3 and 4 millions and occupying some ten years in construction. Their latest achievement is the construction of the Hull Docks, which were opened by King George V. in 1914.

Brilliant as is this record, it is rivalled by the firm's operations in the production and marketing of Mexican petroleum. Their harbor and railway work took them to Mexico, and with the courage that takes a strong grip on big problems, they entered the oil business on a large scale. Great areas of petroliferous territory aggregating hundreds of square miles were acquired. Wells were sunk, oil was found in prolific abundance, and the various oil fields developed; while reservoirs, tanks, pipe lines, pumping stations, refineries and loading terminals were simultaneously installed. The oil side of the firm's business was eventually formed into a separate organization, the Mexican Eagle Oil Company, Limited, which has a capital of £5,000,000.

Equipped with a unique engineering experience, great financial resources and the most skilled operators for all the numerous phases of oil production, the company has made great strides, not only securing the bulk of the internal Mexican trade (after a fierce fight with the Standard Oil subsidiary and the loss by fire of the great gusher at Dos Bocas), but also entering the markets of the world and even supplying Mexican oil to the two greater oil producing countries, namely, the United States and Russia. A fleet of giant tank steamers of 15,700 tons capacity, together with smaller vessels, has been rapidly built by an allied company, the Eagle Oil Transport Company, while the marketing is done by still another company known as the Anglo-Mexican Petroleum Products Company. In the gradual building up of this group of companies may be seen the genius and thoroughness of Lord Cowdray. "In him" (we again quote Mr. T. P. O'Connor) "you have the combination of imagination, hard reasoning and expert knowledge, accompanied by a temperament having a courage that never fails, a purpose that never wavers and a grip that never relaxes."

In the conflicts of human beings and human interests, in every sphere of life, battles are lost not so much by want of courage in the initiation as by exhaustion of tenacity or vacillation of nerve in the middle of the fight, when the issue seems still doubtful. It is because he never feared and never either doubted or vacillated that Lord Cowdray has passed scatheless through these battles of giants in the giant enterprises in which his life has been spent.

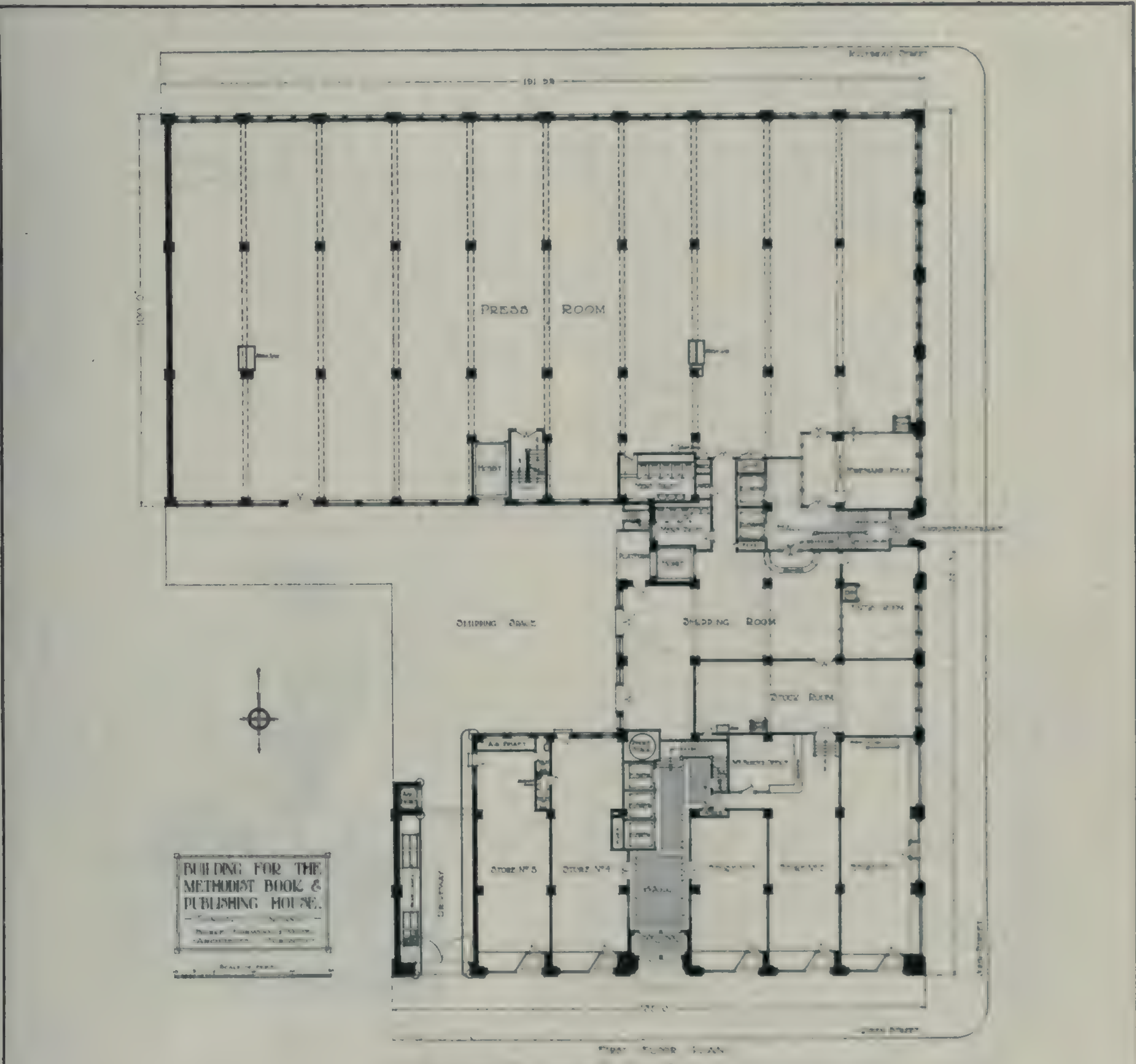
Toronto Publishing House, now Nearing Completion, which Exemplifies Progress in Design and Construction

(Staff article)

THE new Methodist Book Room, Toronto, which contains many interesting features of design and construction, occupies a frontage on Queen Street of 136 feet, on John Street of 221 feet, and on Richmond Street of 192 feet. A part of the site is upon the bed of a creek which passed on through the old Upper Canada College Grounds and the old Government House Grounds on its way to the Bay. Considerable trouble was experienced with water, and constant pumping was required after the excavation for the sub-basement extended below the level of the street sewers. The floor of the boiler room is 27 feet below street level, while the sub-basement for the ash conveyor, etc., is 12 feet deeper. The building is designed for ten storeys in height, but five have been built in addition to the basement.

The building is of the steel frame or cage type of construction, requiring about 2,200 tons, and the loading is such that it was deemed advisable to extend the column foundations to shale rock, which averaged some 40 feet below the level of the sidewalk. The foundation caissons are of concrete, varying from 4½

The new Methodist Book Room, Toronto. From a photograph taken for THE CONTRACT RECORD last week.



First Floor Plan, Methodist Book Room.

to 8½ feet in diameter, and are capped by steel grillage beams supporting the cast iron bases of the column above.

The floor construction in the office or Queen Street side of the building is of hollow tile, while that of the manufacturing portion on John and Richmond Streets is of reinforced concrete, with ceilings finished smooth enough for painting. The Press Room floors are calculated for a live load of 400 lbs. to the square foot.

The building is faced on all the street sides with mat glazed terra-cotta, and is Gothic in design.

The Sub-Basement is occupied by the Boiler and Sump Rooms. There are two boilers of the latest Goldie & McCulloch water tube type, each rated at 300 h.p., with space for two additional boilers of similar capacity when required. As it is intended to only partially supply the required electric current (using the engines now in the present establishment on Temperance Street), one boiler will be sufficient for the purpose.

The building is heated by exhaust steam, or by direct steam, as may be desired, and all piping is arranged to suit the enlarged building.

The basement is devoted largely to paper storage purposes. In addition to this there are receiving rooms, a room for oil storage, fuel room, employees' lockers, engineer's office, machine shop, engine and pump rooms, carpenter's shop, and store rooms.

The first (or ground) floor has five shops on the Queen Street front. One of these is to be devoted to the retail trade of the Book Room, while the others are to be rented. The main entrance is located in the centre of the Queen Street front and there is a driveway at the east end giving access to the court, under which are located the boiler and fuel rooms. This court is also to be used for shipping and receiving purposes, no goods being handled on the street frontages.

The employees' entrance is located at about the middle of the John Street frontage. Between it and the shops are the entry, shipping, and stock rooms.

The entire southerly section is one large press room. Provision is made for three passenger elevators, two being installed for the present. There are also two employees' elevators, two freight hoists, and four dumb waiters, all electrically driven.

The second floor is devoted to the wholesale department, with sample room and offices in the front section, while the entire area over the press room section is given over to the bindery department. The easterly five bays of this section on Richmond Street do not, for the present, extend higher than the bindery floor.

The third floor contains, on the Queen Street front, the general offices of the Book Room, with private offices for the Book Steward and his assistants, stenographers, and lunch rooms, toilet, coat rooms and vault. The centre section accommodates the library stock and the printing offices, while the rear portion of the John Street front and the Richmond Street section accommodates the job, stereotype, and proof readers' rooms.

The fourth floor is arranged, on the Queen Street front, for connectional offices and large Board Room suitable for Ministerial Association and other meetings. The centre section is devoted to men's and women's lunch and rest rooms, and the rear or Richmond Street section to the linotype department. The fifth floor is devoted entirely to connectional or other revenue-producing offices. On the roof are located the pent-houses for fan and elevator machinery rooms.

The entire structure has been made as nearly fireproof as possible. All the sashes and frames are metal, and the windows opening into the court are glazed with wired glass. A great number of the interior sash and borrowed lights are also metal. The building is divided into sections by automatic fire-doors. The flooring, where wood is not absolutely essential, is finishe din concrete, asphalt, terrazzo, or marble. The cost will be in the neighborhood of $750,000, exclusive of land.

The architects are Messrs. Burke, Horwood & White, and the general contractors are Messrs. John H. Parker Canadian, Limited, Toronto.

The plumbing and heating are being executed by the Bennett & Wright Company, who are also installing the pumps. The Goldie & McCulloch Company are installing the boilers, with the stokers and ash-handling equipment. The electric wiring is being executed by Mr. Harry Alexander, the elevators by the A. B. See Electric Elevator Company of Canada, Limited, and the hardware by the Aikenhead Hardware, Limited.

It is "Business as Usual" with the New Brunswick towns. At St. John the Commissioner of Water and Sewerage is asking for a bond issue of $24,000 to enable water extensions to be made to outlying localities; Chatham has authorized an issue of $20,000 for the same purpose; St. Stephen, Woodstock, Fredericton, Moncton, Sackville and other New Brunswick towns are also adding to their civic undertakings.

In urging the necessity of buying made-in-Canada goods, at the Hamilton Manufacturers' Smoker last month, Mr. E. G. Henderson, President of the Canadian Manufacturers' Association, told his audience that manufacturers must try to set the example of patronizing home industry. He pointed out that now was the opportunity for Canadian manufacturers to build up an international reputation for the quality of their products.

The Sand-Lime Brick Industry in Canada

Specially Contributed by Geo. Silvester, Calgary, Alta.

THE sand-lime brick industry was introduced into America some twenty years ago, although the product and its manufacturing process were known in Germany as long ago as 1880. It was in this year that we first heard of the sand-lime brick being hardened by the steam process.

When it was first introduced into Canada, the sand-lime brick process was not a huge success, as architects and builders regarded it as a new and untried quantity, and worse—in their opinion—as an unknown one. For the first few years the new bricks were not looked upon with favor, but to-day they are established in many of the largest cities of Canada and the United States. In Canada their use is not restricted to one process. There are conspicuous examples of sand-lime brick in Montreal, Ottawa, Peterborough, Toronto, Brantford, Port Arthur, Winnipeg, Brandon, Moose Jaw, Prince Albert, Saskatoon, Regina, Calgary, Edmonton and Vancouver. After we have traversed the Canadian provinces we can go further and find the brick all the way from Cuba to China. The Chinaman is employing this material with great success.

Mr. George Silvester.

If I were to be asked the extent of the industry in the Canadian territory I would say that there are, as far as I know, one hundred and five sand-lime brick yards, with an annual output of two million five hundred thousand brick each for the season.

In its natural color the brick is grey, resembling Indiana sandstone. It is made in various colors—principally red, buff, and dark grey. Any one of these set up in black mortar is artistic and produces a splendid contrast. Sand-lime brick has come to stay, and it is entering increasingly into the material used in building construction to-day.

The extent to which the trade is going ahead is due largely to the efforts of the American Sand-Lime Brick Association, which holds its Annual Convention at points in Canada and the United States. At these conventions the brick situation is discussed thoroughly in all its aspects. In this connection it may be of interest to state that Mr. Elmsley, of the U. S. Department of Commerce and Labor, and Bureau of Standards, attends these meetings and gives valuable information concerning tests. In his 1913 report we find the annual output of sand-lime brick in the United States placed at 174,361,000, but at the 1914 convention held at Dayton, Ohio, a steady increase was reported.

Architects are fast changing their ideas, and many are now specifying sand-lime brick. They are popular with contractors, for, owing to the accuracy of their manufacture, they are better to handle than other brick, and the bricklayer never has to drop one and take up another. A few years ago sand-lime brick were used principally for backing up purposes, but now they are coming into use in large buildings—hotels, railway stations, churches and residences.

Essentials in the manufacture of sand-lime brick are a suitable silicate sand and the right proportion of a high grade calcium lime (this is preferable to magnesia lime) hydrated. The chemical action of these ingredients while under heavy steam pressure produces results which no common brick on the market can equal. Sand-lime brick can stand more than common brick under both fire and crushing tests. Another point is that the brick can withstand the climatic conditions of any country where brick are used at all.

The average capacity of a machine, working ten hours, is 20,000. The brick may be used the day after they are made, although manufacturers make a practice of stacking them in open sheds or yards for at least ten days, so that the air may mature them.

In the manufacture of these brick we use various styles of machinery made both in Canada and the United States. The process is varied, but under proper handling in all cases the results are practically constant.

The largest individual sand-lime brick plant that I know of is situated in Germany. This plant turns out—or did turn out!—220,000 brick daily. In the year 1912 it was running to full capacity and could not keep up with its orders.

Constructional Forecast for 1915

Official Returns from the Principal Towns and Cities

REPORTS received from upwards of fifty engineers from all parts of the Dominion would indicate that there will be a fair amount of constructional activity in the municipal line during 1915. In the following reports most of the principal towns and cities have been covered. While a persistent effort was made to obtain news from every municipality, difficulty was encountered in many cases owing to the fact that the plans of the local authorities were in a more or less nebulous condition. In a large number of cases the engineer informed us that the plans of his municipality would depend largely upon the behaviour of the financial market, and that in consequence, action in regard to a considerable amount of constructional work had been deferred. In regard to any items that may be found inadequate it must be borne in mind that even at the best of times few municipalities have their plans properly advanced by the latter end of January—the period at which our information was compiled. Even in this skeleton form, however, the returns are illuminating and promising, conveying as they do the suggestion of an appreciable amount of construction—notably in road work and paving, water-works and sewerage. In a later issue we hope to develop this skeleton outline into a substantial body of facts which will stand as an authoritative and permanent reference to the work of the season.

Amherst, N.S.—Estimated expenditures: paving (concrete or bitulithic), $45,000; sewers, $15,000; water-works (extensions), $10,000.

Barrie, Ont.—Estimated expenditures: roadways, $3,000; sewer extensions, $4,000; sewage disposal, $60,000; garbage collection and disposal, $800; electric light, $2,000; new buildings, $100,000. The expenditure under sewage disposal is to provide for a scheme which has been ordered by the Provincial Board of Health. This project will not be carried out unless it is made absolutely compulsory by this authority.

Battleford, Sask.—Estimated expenditures: grading roads, $1,000; sewers, $2,500; garbage collection, $1,500; electric light (house services and meters), $1,000. The city engineer suggests the possibility of amended estimates.

Beaconsfield, Que.—Estimated expenditures: roadways, $4,600; water-works, $3,500; electric light, $2,000; proposed new buildings, $15,000.

Belleville, Ont.—Estimated expenditures: road work and paving, $20,000; sewer extensions, $15,000; water-works, $12,000.

Berlin, Ont.—Estimated expenditures: roadways, $20,000; sewers, $10,000; sewage disposal, $10,000; garbage incinerator, $16,000.

Brantford, Ont.—Estimated expenditures: roadways and paving, $30,000 (concrete $20,000, macadam $10,000); sewers, $35,000 (storm sewers $5,000, sanitary sewers $30,000); garbage collection and disposal, $12,000; water-works (extension of collecting galleries), $40,000; electric light, $35,000 (enlarging hydro-electric station to supply power to street railway will cost $25,000). The city engineer advises us that the street railway Commissioners are contemplating a further extension of the city lines and the purchase of two new cars. The street railway system is owned by the city.

Burnaby, B.C.—Estimated expenditures: road work, $75,000; sewers, $200,000; water-works, $50,000. The outlay on roads will be for maintenance chiefly, and for the construction of a few earth roads. The details of new sewerage work are not available. The trunk sewers are built for this Municipality by the Vancouver District and Drainage Board, who will probably spend $200,000 in Burnaby this season The water-works extensions will probably total about six miles of new mains.

Camrose, Alta. — Estimated expenditures: roadways (grading and gravelling), $4,000; water-works (installation of new pump), $2,000.

Canora, Sask.—The only important expenditure contemplated this year is $22,000 for water-works. This amount is to cover the balance of a contract for water supply undertaken last fall. The contractors for the work are Messrs. Wm. Newman & Company, of Winnipeg, and the engineers are Messrs. Chipman & Power, Toronto and Winnipeg. The source of supply is a spring three miles east of this town. The total contract involved the expenditure of $60,000, and the work includes collecting galleries, reservoir, pump house, cast iron water mains, and a steel tower on concrete base.

Charlottetown, P.E.I.—Estimated expenditures: sewers, $12,000; electric light (street lighting), $7,000. The sewer system extension contemplated is a 24-in. storm water main.

Details of new road work are not yet available, but it is anticipated that a number of contracts for concrete sidewalks will be awarded.

Chatham, Ont.—Estimated expenditures: road work, $30,000; sewers, $10,000; garbage collection and disposal, $2,000; electric light, $90,000.

Chicoutimi, Que.—Estimated expenditures: road work (to complete 1914 contracts), $30,000; sewer extensions, $2,000.

Cranbrook, B.C.—According to information received from the city engineer, this municipality will expend $30,000 this season upon the completion of the water-works extensions undertaken in 1914. The work consists of replacing wooden pipe with steel mains and building a new dam. The estimated cost of the whole undertaking is $97,000.

Dundas, Ont.—Estimated expenditures: road work, $5,000; sewers, $50,000; sewage disposal, $20,000; water-works, $4,000; electric light, $5,000. The expenditure for road work will be for maintenance, with the addition of a few brick crossings. In the field of garbage collection and disposal, the outlay will be for collection only. The water-works extension will consist of building a concrete dam.

East Kildonan, Man.—Estimated expenditures: road work (grading and gravelling), $6,000; sewers, $44,000; water-works (additional mains), $49,000. The engineer advises us that there are no water mains or sewers, with the exception of an outfall sewer, in the municipality at present, and that the expenditures in this department are for the initial undertaking.

Estevan, Sask.—Estimated expenditures: road work, $1,000; sewer extensions, $3,000; water-works, $2,000; electric lighting system, $6,500.

Fernie, B.C.—Estimated expenditures: road work, $5,000; sewers, $12,000; water-works, $2,700; electric light, $2,000; new buildings, $35,000. The road work will consist of the laying of macadam roads. The sewer extensions are for new mains, which will be of 8-in. to 15-in. concrete or vitrified sewer-pipe. The water-works extensions will consist of laying 12-in. cast iron and 4-in. wrought iron mains. The electric light extension is for a proposed new line for power purposes only. The building projects for 1915 include a drill hall and armoury for the Provincial Government. The city engineer informs us that last year the city purchased a 12-ton Watrous road roller and a Champion rock crusher, at a cost of $5,000. At the close of the season the city had finished 5,000 square yards of macadam, at a cost of $4,200. Some 8,000 lineal feet of six-foot plank sidewalk was laid, at an outlay of $5,000, while lighting extensions to the value of $6,000 were carried out. A street lighting system was completed at a cost of $3,000, and renewal work for power house machinery cost another $1,000.

Fort Frances, Ont.—Estimated expenditures: road work (repairs, new grading and gravelling), $15,000; sewers (new mains), $15,000; water-works, $12,000; electric light, $4,000. In regard to building work, the city engineer writes, "Owing to the war, building activities are not expected to be very marked, but we expect to erect a new post office, and there are signs of activity in residential and business building. Naturally the bond market will have a great deal to do with the amount of construction."

Fort William, Ont.—The city engineer reports the passage of the following by-laws last month:—for water-works extensions, $65,000; for clearing the watershed of Loch Lomond, $12,000; for the erection of a market building, $22,000. During 1914, the sum of approximately $400,000 was spent on local improvements. This outlay covered the following work:—asphalt paving, 2.17 miles; macadam, 4.48 miles; gravelling, 8.65 miles; grading, 1.60 miles; sewers, 3.15 miles; concrete walks, 0.83 miles; plank walks, 5.95 miles. Street railway construction, which amounted to eight miles of single track, involved the expenditure of $260,000, while $33,000 was spent on electric lighting and $89,000 on telephone extensions. A feature of the work of 1914 was the entire reorganization of the Scavenging Department. The operation of the incinerator plant and street railway service was inaugurated last year. The flushing of pavements and oiling of streets was commenced for the first season. About four miles of water mains were added to the distributing system, and a weir gauge recording apparatus was installed at Carp River, Loch Lomond.

Galt, Ont.—Estimated expenditures: road work and concrete sidewalks, $28,500; sewer extensions, $50,000; water-works, $35,000; electric light, $27,500; new buildings, $400,000.

Hamilton, Ont.—Estimated expenditures: road work, $100,000; sewers, $130,000; sewage disposal, $30,000; garbage collection and disposal, $35,000; water-works, $52,500; electric light, $90,000. The city engineer advises us that there is ahead of his department only the construction of the east end sewer, pumping station and rising main, besides the west end sewer and water-works system, which will cost respectively $170,000 and $250,000.

Kamloops, B.C.—In a recent communication to the Contract Record, the city engineer stated that the city will probably undertake about five miles of street "oiling" this season, in which case it would be looking for a suitable oil spray apparatus and accessories. However, in regard to the activities of the city, he informs us that machinery may be required for one or more sub-stations in connection with the hydro-electric plant which was commenced in 1912 and has now been completed. Negotiations are coming forward for the erection of a pulp plant, and, in all probability, a flour mill will be established at Kamloops.

Lethbridge, Alta.—Estimated expenditures: road work, $16,000; sewers, $15,000; sewage disposal, $2,000; garbage collection and disposal, $11,000; water-works, $37,500. The road work will consist of paving subway and approaches. The sewerage system expenditures are for the extension of sanitary sewers, 8 in. to 12 in., and the installation of chlorinating plant and minor alterations to the sewage disposal works. The water-works extensions are for the completion of high pressure system (12-in. to 24-in. steel pipe), and new intake and sedimentation basin. In the field of electric light, little capital expenditure is anticipated. An estimate of building work, based on the 1914 figures, is $500,000 for the season of 1915.

London, Ont.—Estimated expenditures: road work, $200,000; sewers, $80,000; sewage disposal, $50,000; garbage collection and disposal, $40,000; water-works, $60,000; electric light, $80,000; building construction, $2,000,000. The details of road work expenditure are as follows:—asphalt, $170,000; concrete, $20,000; vitrified brick, $10,000.

Melville, Sask.—Estimated expenditures: road work, $30,000; sewers, $40,000; garbage collection and disposal, $3,000; building construction, $200,000. The estimated expenditures for roadways, paving and sewerage are based on an authorized issue of debentures, some of which have been sold. The town engineer reports that the local Council are confining themselves to construction that is absolutely necessary, pending further developments of the war in favor of the allies, so it is possible that the above expenditure may be enlarged at a later date. The outlay on building work will be governed by municipal construction.

Moose Jaw, Sask.—Estimated expenditures: road work (19,000 square yards of paving), $87,000; sewerage system, $140,000 (extension of mains $130,000, sewage disposal work $10,000); garbage collection and disposal, $27,000; water-works, $46,000; electric light, $156,000; new buildings, $250,000.

Mount Forest, Ont.—Estimated expenditures: road work, $1,000; water-works (new pumps), $2,000; electric light (new system), $10,000.

New Glasgow, N.S.—Estimated expenditures: road work, (general repairs and maintenance), $10,000; sewers (extension of laterals and one small extension to outfall sewer), $8,000. The programme of improvements will be definitely decided when new council takes office.

New Westminster, B.C.—Estimated expenditures: road work, $160,000; sewers, $371,000; water-works, $45,000. The estimated expenditure of $160,000 on road work is to meet a contract which is now held up pending the more favorable condition of the bond market. Road work to the value of $70,000 is under way. The outlay for sewers is divided into $150,000 for the first installment of the New Westminster-Burnaby trunk sewer, upon which work has started; the balance is money actually in hand for the Sapperton No. 2 scheme. No disposal works are included. The water-works extensions will consist of a new 5,000,000-gallon reservoir.

North Battleford, Sask.—Estimated expenditures: road work (street grading and surfacing with gravel), $10,000; sewers and sewage disposal, $27,000; (sprinkling filters and disinfecting chamber, $15,000; laying of tile sewer on Railway Avenue $12,000), water-works (infiltration galleries to intake well), $3,000.

North Bay, Ont.—Estimated expenditures: road work, $80,000; granolithic sidewalks, $5,000; sewers (extension to mains), $20,000.

Oshawa, Ont.—Estimated expenditures: road work, $42,500; sewers, $2,000; water-works, $2,500. The road work consists of concrete paving on King St. W., to cost $17,000, and concrete or brick paving on Simcoe Street S., to cost $25,000. The sewer extensions will consist of 8-in. glazed vitrified tile sanitary sewers. A report on the water supply is to be submitted, but new construction is not anticipated this season, beyond the installation of a few supply mains at a cost of some $2,500. A report is to be submitted in connection with the proposed King Street bridge, which, if adopted, will mean an outlay of $10,000. The town engineer reports the outlook bright. With some improvement in the market for bonds, he anticipates greatly increased municipal activity, of which the above details are a poor criterion.

Parry Sound, Ont.—Estimated expenditures: road work, $5,000; water-works, $17,000; new buildings, $12,000. The extensions to the water-works will consist of new mains and a new tank, which will be commenced in the early spring.

Peterborough, Ont.—Estimated expenditures: road work, $60,000; sewers, $70,000; sewage disposal, $150,000; garbage collection and disposal, $7,000; water-works, $50,000; electric light, $75,000; building construction, $500,000.

Prince Rupert, B.C.—Estimated expenditures: road work, $60,000 (rough grading $12,000, plank roadways $48,000); sewage disposal, $5,000; garbage collection and disposal, $10,000; water-works maintenance and operation, $6,000; completing hydro-electric undertaking, $5,000; electric light maintenance and operation, $54,000. The city engineer advises us that a by-law to raise $320,000 for sewer extensions has been approved by the ratepayers, and that the work will proceed if the scheme can be financed. He tells us that Prince Rupert probably has felt the strain of the present situation as little as, if not less than, any city on the coast, and that it may be one of the first places to benefit from the improvement in the money market. At the time of writing (January 18th) practically every building in the city was occupied.

Redcliff, Alta.—Estimated expenditures: sewerage system, $190,000; garbage collection and disposal, $6,000; waterworks, $35,000. The expenditure for sewers is made up of $135,000 for trunk sewer, and $55,000 for various street sewers.

St. Catharines, Ont.—Estimated expenditures: roadways and paving, $50,000; sewers (relief sewer and extensions to sewer system), $75,000; garbage collection and disposal, $8,000; water-works (extension to mains), $10,000; electric light (completion of hydro-electric system), $40,000. The city engineer advises us of the completion of the Ontario Street bridge, at a cost of $139,000, and of the commencement of the St. Paul Street high level viaduct, estimated to cost $220,000.

St. Lambert, Que.—Estimated expenditures: road work, $140,000; sewers, $175,000; garbage collection and disposal, $2,000; water-works, $8,000; electric light, $12,000. The bulk of the road work expenditure is for concrete paving. The outlay for the sewerage system will be for extensions to trunk sewers and a sewage disposal plant, plans of which are completed and will be adopted as soon as possible. The money to be spent on water-works is for power and maintenance purposes, and the work includes one new 75 h.p. pump for emergency purposes. The electric light expenditure includes $5,000 for line extensions. The trunk sewer and sewage disposal projects will be governed by the availability of funds.

Sherbrooke, Que.—Estimated expenditures: road work and paving, $30,000; sewerage system, $1,000; garbage collection and disposal, $2,000; water-works system, $28,000; garbage disposal, $2,000; electric light, $110,000. These estimates were not passed at the time the details were provided by the city engineer.

Smiths Falls, Ont.—Estimated expenditures: road work, $6,000; sewer extensions, $10,000. The building projects this season include a Collegiate Institute, at a cost of $60,000, and new City Hall, at a cost of $30,000.

Steelton, Ont.—Estimated expenditures: sewer extensions, $30,000; water-works (supply main extensions), $15,000; electric light—minor extensions. The town engineer advises us that Steelton now obtains its water supply from deep wells, and that the city of Sault Ste. Marie may possibly endeavour to secure its supply from the same source, in which case considerable expenditure on water-works extensions may be anticipated.

Stratford, Ont.—Estimated expenditures: roadways and paving, $100,000; sewers and sewage disposal, $29,000; garbage collection and disposal, $8,000; water-works, $18,000; electric light, $27,000.

Sudbury, Ont.—Estimated expenditures: road work, $20,000; sewers, $15,000; garbage collection and disposal, $4,000; water-works, $2,000; electric light, $10,000. The water-works superintendent advises us that variations in these figures may be expected, according to the behaviour of the money market.

Sydney, N.S.—Estimated expenditures: sewers, $3,000; water-works, $20,000. The expenditure on water-works is for pump house, intake and one 3,000,000-gallon motor-driven centrifugal pump. The only construction expected by the city engineer at present is the Middle Lake pumping station. Road work this season will be practically a negligible quantity.

South Vancouver, B.C.—Estimated expenditures: roadways and paving, Main Street, $162,000, Fraser Street, $380,000; sewers, $400,000; incinerator and garbage collecting stations, $50,000; water-works (extension of distribution system), $30,000.

Souris, Man.—Estimated expenditures: roadways, $6,000; sewers, $9,000; water-works, $8,000; building construction, $60,000. The town has no paved streets, and the expenditure on road work is for grading and gravelling. The outlay on sewers is to cover the possible extension of the system to West Souris. A contract for garbage collection and disposal is awarded locally each year. The water-works are to be extended to West Souris. The electric light plant has only just been completed, and no extensions are in view. The building projects include an armoury, at an estimated cost of $28,000. The town engineer reports that these figures are only approximate, and that their expenditure will be governed by the money market.

Toronto, Ont.—Estimated expenditures: local improvements, $3,000,000; street railway track allowance reconstruction and repairs, $800,000; water-works improvements, $840,065; water revenue mains, $175,000; Bloor Street viaduct, $400,000; filtration plant extension, $800,000; main pumping station extension, $250,000; high level pumping station extension, $175,000; 84-inch conduit (Island), $75,000; 72-inch conduit from new mechanical filtration plant to 72-inch and 84-inch conduits, $110,000. In reference to the activities of his department, the Street Commissioner, Mr. George B. Wilson, reminds us that an incinerator is to be built on the east side of the Don River, and is to be completed by next December. Mr. Wilson writes:—"We shall endeavor, moreover, to prevail upon the Council to adopt a recommendation looking to the acquirement of additional sites, in order that we may proceed with the erection of a second incinerator, shops, stables, etc. If this second site be acquired, we shall then be in a position to erect stables and a third plant upon the site known as the Strachan Avenue Yard, which will replace the yard now located on King Street, near the corner of Dufferin Street. This latter work, however, cannot be proceeded with until a decision has been reached with regard to the other sites, inasmuch as if we are not permitted to secure additional sites, the character and capacity of the plant and stables to be erected on the sites already acquired will have to be greatly augmented. In addition to the foregoing, we are getting out plans for the erection of an incinerator on the Island to replace the structure which has been doing duty in that section of the city for many years past, and which has outlived its usefulness. The expenditure in connection with the erection of the authorized incinerators (exclusive of stables, etc.), is approximately $250,000. If, however, the Council authorizes the Department to proceed with the plans which are being outlined as to stable accommodation, etc., and which accommodation is urgently required, the total expenditure will approach in the neighborhood of $400,000."

Trenton, Ont.—Estimated expenditures: paving (concrete or asphalt), $15,000; completion of sewers, $10,000.

Victoria, B.C.—Estimated expenditures: road work and paving (not including maintenance), $100,000; sewers (North West main trunk sewer and mains), $160,000; garbage collection and disposal, $60,000; water-works (exclusive of the extension of city mains, service maintenance, etc.), $175,000; electric light, $43,000.

Westmount, Que.—Estimated expenditures: garbage collection and disposal, $26,000; electric light (underground conduits, cables, transformers, meters, etc.), $50,000. Details as to road work, sewers and water-works are not decided.

American Road Builders' Association — Election of Officers

Mr. George W. Tillson, Consulting Engineer to the President of the Borough of Brooklyn, N.Y., was elected President of the American Road Builders' Association at the recent annual meeting of that body in New York City.

Other executive officers for 1915 were elected as follows: First Vice-President, Mr. A. W. Dean, Chief Engineer, Massachusetts Highway Commission; Second Vice-President, Mr. Austin B. Fletcher, State Highway Engineer of California; Third Vice-President, Mr. S. Percy Hooker, State Superintendent of Highways of New Hampshire; Secretary, Mr. E. L. Powers, New York City; Treasurer, Major W. W. Crosby, Consulting Engineer, Baltimore, Md.

In addition, the following were elected directors for three years: Mr. E. A. Fisher, City Engineer of Rochester, N.Y.; Mr. A. R. Hirst, State Highway Engineer of Wisconsin; Mr. Joseph W. Hunter, First Deputy Commissioner, Pennsylvania State Highway Department; Mr. Frank F. Rogers, State Highway Commissioner of Michigan; Mr. William R. Smith, General Manager, Lane Construction Corporation, Meriden, Conn., and Mr. H. M. Waite, City Manager of Dayton, Ohio.

The annual banquet of the Association was held at the Hotel Astor. The retiring President, Mr. W. A. McLean, Chief Engineer of Highways for the Province of Ontario, acted as Toast-Master.

The Constructional Activities of Westmount, Que.

Some matters of constructional interest are dealt with in a report covering two years to October 31st last compiled by Mr. G. W. Thompson, General Manager of the Westmount Council. The city has spent many thousands of dollars during the period under review in opening up thoroughfares, constructing permanent pavements of concrete and asphalt, sewers, and otherwise improving the city. A new departure partaking of the nature of a trial has been made in paving in reinforced concrete a considerable section of the lanes. This work involved draining. The improvement is such that it is expected there will be a general desire for the work to be pushed until every lane has been paved. Mr. P. E. Jarman, the city engineer, reports that there are now 26.965 miles of roads and pavements, of which 9.178 miles are of tar macadam (pouring method) and 7.452 asphalt surface pavement. There are 29.199 miles of sewer, 47.584 of concrete walks, 12.687 concrete curbs and gutters, 1.529 block crossings and .62 lanes paved with concrete. The city has carried out a new street lighting system of inverted arc lamps on ornamental standards. This it is intended to extend and to introduce smaller standard arc lamps on the cross streets. This will enable the unsightly poles to be removed, the cables for lighting, telephone and other purposes being carried in underground conduits. The city has its own lighting and power department, and the profit for the two years amounts to $74,923, which has been spent in extensions. The building permits for last year totalled $1,051,595, a decrease of $787,846, the average cost of the buildings being $6,613, as against $8,323 in the previous year.

The 26th annual dinner of the Engineering Society of the University of Toronto was held at the Prince George Hotel, Toronto, on the evening of Friday, February 12. Addresses were given by a number of prominent public men, including the Hon. W. H. Hearst, Premier of Ontario, and Mr. Thos. R. Deacon, ex-Mayor of Winnipeg, and President and General Manager of the Manitoba Bridge and Iron Works, Limited, who graduated from the School of Practical Science in 1891. The undergraduates enlisted with the Over-Seas Contingents were guests of the Society.

Plans for a new mountain hospital have been approved by the Hamilton (Ont.) Hospital Board. The initial scheme is for the construction of sufficient buildings and plant to provide for about sixty patients. The cost of the structure is estimated at $150,000. Later, as financial advantages warrant, and actual needs demand, other buildings providing for the accommodation of patients up to the number of five hundred will be constructed.

Dr. J. W. S. McCullough and Mr. H. Dally, of the Provincial Board of Health, went to Ottawa last week to look into the proposal to construct a pipe line to Lemieux Island in the Ottawa River, for the purpose of supplying the city with water power for fire purposes. It is understood that they will not give their sanction to the proposal unless the construction of the water supply from Thirty-One Mile Lake be commenced at the same time.

Comprehensive Scope of Toronto's Forthcoming International Road Congress

ALTHOUGH the International Roads Congress, which is to be held in Toronto, is five weeks off, indications point to a large attendance. The officials will be disappointed' if two thousand delegates are not present.

The Province of Quebec will be represented by a strong delegation of Ministers, and the Roads Department has promised to exhibit photos and models showing the various types of roads in the province.

Following is the official synopsis of the subjects to be discussed:

Finance.—To meet the cost of roads on an equitable and popular basis is one of the chief problems of the good roads movement. "Ways and means" is a topic of primary concern to councils and the public.

Road Location.—Roads in Canada are largely located to suit property lines rather than for suitable foundations and grades, thereby increasing the cost and difficulty of construction. The influence of location, methods of deciding existing roads, and of straightening or otherwise improving the location will be of interest.

Traffic.—Roads should be built to suit the traffic over them. Changing traffic conditions, the need of regulating traffic, of limiting loads, speed and width of tires, make the subject one of timely importance.

Sub-Grade.—Proper treatment of the natural soil on which the road crust is to be laid, was one of the fundamental principles discussed by Macadam, and which revolutionized methods of road making a little over a century ago.

Drainage.—Good surface drainage and sufficient underdrainage are necessary for success in the construction of roads and pavements. Methods of drainage are at all times a subject of interest to road builders, whether dealing with earth roads, gravel roads, stone roads, or surfaces of a higher type.

Road Foundations.—The enduring part of a road if properly built is the foundation. Surfaces wear and must be renewed; and should we give more attention to the foundation? The value of permanent foundations is a phase of road-building which should receive serious consideration.

The Wearing Surface.—A durable wearing surface is invaluable to cities, towns and on country roads. The selection of a wearing surface adapted to local traffic is one of the chief duties of the highway engineer, and the matter is one of wide public interest. Modern traffic has made the problem a very complex one, and the "best road" is the surface best adapted to local traffic and materials available.

Concrete Roads.—The use of concrete for road surfaces is a comparatively new departure, but is attracting the keen attention of highway engineers. A description of this material to date and the best methods of construction will bring out many facts on which all who are interested in road improvement should be informed.

Brick Pavements.—Brick is well known as a useful and durable material for road and street pavements. It has been largely used in Canada for town and city streets, and its adaptation to country roads, successfully followed elsewhere, is deserving of careful consideration by the Canadian public.

Bituminous Roads.—The use of tar and asphalt in road construction has developed on standard lines based on much experience. The excellent road surfaces of Great Britain are largely bound or treated with bituminous materials, but the accumulating knowledge of these materials, methods of using, and results to be expected form an ever interesting topic.

Dust Prevention.—Increasing traffic on streets and main roads has made the matter one of much interest to property owners and users of the roads. Dust prevention is closely associated with the preservation of the road surface, and is receiving the careful study of all road experts. Progress in the problem is one which is being followed with close attention by the Councillors and the public.

Bridges.—Bridge construction is a department of road-improvement which often demands immediate and large expenditure to ensure the safety of the travelling public. Loads passing over bridges are increasing, while many wooden structures are growing weaker from decay. To replace wooden bridges with durable steel and concrete structures is a matter of pressing importance in many localities.

Culverts.—The cost of the individual culvert is comparatively small, but to place them on the roads in large numbers and to keep them in repair is a serious tax on funds available for road improvement.

Mr. W A McLean, President of the Congress.

Road Maintenance.—There is no such thing as an absolutely permanent road. The problem of maintenance is one which must be seriously considered by the public of Canada.

Road Machinery.—Manual labor has been largely displaced in road construction by machinery and labor-saving appliances. More perfect results, and at less cost, are being brought about by this means. To know how to build roads one must know the many types of machines available, the conditions and purposes to which they are applicable, and methods of operation.

Wooden Blocks.—The value of preserved wooden block for street pavements has been demonstrated in the large cities of the world, and their use is increasing.

Earth Roads.—It is probable that for the next quarter century seventy-five per cent. of the roads on this continent will continue to be earth roads. To obtain the best possible service at reasonable cost from earth roads is a problem demanding careful consideration and immediate action. The

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The Second Canadian and International Good Roads Convention, Toronto, March 22-28.

keynote is "organization." How can municipal councils deal effectively with the matter?

Gravel and Macadam Roads.—The greater mileage of surfaced roads in Canada must continue to be made with gravel and broken stone. They are primarily the roads of moderate farm traffic, and their construction has been reduced to standard practice. Councillors can profitably understand them in all details. Ratepayers should know their limitations in meeting the needs of traffic, and should understand the organization necessary to produce good results in construction and maintenance.

The President of the Congress is Mr. W. A. McLean, Toronto, Chief Engineer of Highways for Ontario, and the Secretary, is Mr. Geo. A. McNamee, New Birks Building, Montreal.

The Convention headquarters will be at Convocation Hall, University of Toronto.

Personal Mention

Mr. R. G. Harvey, Town Engineer of Duncan, B.C., has resigned.

Mr. J. A. Baird, Town Engineer of Leamington, Ont., has submitted his resignation.

Mr. William Parker has been appointed Superintendent of the Hamilton, Ont., Street Railway Company.

Mr. David McGill, builders' supplies, has removed to larger offices at 320 Lagauchetiere Street West, Montreal, from 83 Bleury Street.

Mr. Chas. David Marx, Professor of Civil Engineering at Leland Stanford, Jr., University, has been elected President of the American Society of Civil Engineers.

Mr. A. Kilpatrick succeeds Mr. H. McCall as superintendent of the Edmonton-Prince George division of the Grand Trunk Pacific, with headquarters at Edson, Alta.

Mr. J. P. Hynes, Toronto, architect, has removed from his office from 199 Yonge Street to 105 Bond Street, and has taken into partnership Mr. Isadore Feldman and Mr. A. E. Watson.

Messrs. J. M. Wilson and R. G. Saunders have retired from the firm of Messrs. Wilson, Townsend & Saunders, engineers and contractors, Toronto, and in future the business will be carried on by Mr. C. J. Townsend.

Mr. H. McCall has been appointed Superintendent of the Winnipeg-Watrous main line division, and of the Melville-Canora branch of the Grand Trunk Pacific, with headquarters at Melville, Sask., succeeding Mr. G. S. Cooke, resigned.

Dr. E. L. Corthell, of New York, was elected president, Mr. C. Sooysmith, of New York, vice-president, and Mr. F. A. Molitor, of New York, secretary, at the election of officers held at the annual meeting of the American Institute of Consulting Engineers last month. Messrs. A. Hazen, Geo. Gibbs and Chas. Lucke, all of New York City, were elected to fill vacancies in the Council.

Mr. W. G. McIntosh has recently been appointed Sales Engineer for Toronto by the Herbert Morris Crane & Hoist Company, Limited, well-known makers of lifting and shifting machinery. Mr. McIntosh graduated from the School of Practical Science in 1909, obtaining an Honor Degree in Mechanical Engineering. With the Otis-Fensom Elevator Company, the Toronto Power Company, the Canada Foundry Company and the Dominion Bridge Company, he obtained a varied experience of shop work, drawing office and field erection which should stand him in excellent stead in his new position.

The Commissioner of Commerce

Mr. R. Grigg, Commissioner of Commerce for the Dominion of Canada (to whom the Contract Record is indebted for much valuable co-operation), spent his early life on a farm in Ontario and later had a successful career as a manufacturer in Great Britain. During that period he was active in the Press and on the platform as a missionary for the gospel of a great Canadian future, and the urgent need for a better understanding of that fact in the Mother country.

On retiring from business in 1905 he accepted a commission from the Imperial Government to visit Canada and report upon the economic condition of the country, having special regard to British trade. The report upon his visit attracted world-wide attention and probably enjoyed a larger circulation than any other blue book ever published. Nearly every British paper throughout the Empire dealt with it both by leaders and extracts, and long extracts were translated and appeared in foreign journals. It was stated in the Canadian press at the time that no single influence had so important a share in attracting favorable attention to Canada, with the resulting effect upon the money market and emigration, as this report.

Mr. R. Grigg, Commissicner of Commerce.

In 1907 the British Government decided to appoint an officer as head of the British Commercial Intelligence Service in Canada. The appointment was offered to Mr. Grigg, and after four years' activity with headquarters in Montreal, the Canadian Government sought his services and he accepted the position of Commissioner of Commerce with the rank of Deputy Minister. The result of his three years' work under Sir George Foster is apparent to all who avail themselves of the services of his Department as an aid to business. The Weekly Report has doubled in size and more than doubled in circulation during the last two years. Reorganization of a Department is a slow and difficult business but the energy and ability of Sir George Foster is laying the foundation of invaluable work for the Dominion. He has raised his Department from the position of having been the most insignificant and least effective of the Government Agencies to the very front rank, and given it the authority it should command in a country of vast natural resources and destined to be a great manufacturing and exporting country.

What is being done in this Department recalls the transformation effected by Mr. Joseph Chamberlain when he chose to represent the Colonial office in London—at that time an insignificant Department. By the application of his commanding ability and energy he raised it to the position of one of the most important British Governmental Agencies.

Mr. Grigg has the warm appreciation and unstinted regard of every member of the community who has been brought into contact with his work.

A Distinguished French-Canadian Engineer

Mr. Paul A. N. Seurot, of Montreal, who was recently awarded the Gzowski Medal of the Canadian Society of Civil Engineers* for his paper on Subaqueous Tunnelling, is an engineer whose wide experience makes him a particularly happy subject for a short sketch in our British Empire Number. The particular happiness that we derive in making this reference to Mr. Seurot springs partly from the fact that Mr. Seurot is a native of our good ally, France. Born in Paris in 1869, he graduated from l'Ecole Turgot, Academie of Paris, taking post graduate courses in science and letters while engaged as an instructor at l'Ecole Fenelon from 1887 to 1889. He left the French capital for New York in 1890 and was employed by Messrs. Jacobs & Davies on the early surveys and studies for connecting the Long Island railroad lines in Brooklyn to the Pennsylvania railroad system in Jersey City. After an extended experience in various branches of railroad work, he took charge of several important engineering undertakings for Messrs. Jacobs & Davies. His work for this firm included bridge work, river and harbor work, coast survey and water development projects on Long Island, rapid transit, underground and tunnel work. Mr. Seurot has had a practically uninterrupted connection with Messrs. Jacobs & Davies and has been identified with some of the largest projects of that firm. Coming down to more recent years, in 1907 he went to Norfolk to report on the construction of a street railway tunnel under the Elizabeth River, connecting Portsmouth and Norfolk, after which he was sent to France to report to the French Minister of Public Works on the construction of a tunnel for the Western State Railway, under the estuary of the River Seine, near Havre. On the completion of this report he was retained as consulting engineer, representing Messrs. Jacobs & Davies, and taking charge (for the contractors) of the construction of the Concorde Tunnel under the Seine, this being Section No. 8 of the Paris Metropolitan Underground.

On the completion of this work, in 1911, Mr. Seurot was sent to Montreal as Chief Engineer for the New York firm to manage their affairs in Canada. It may be of interest to state that for a short period in 1899 Mr. Seurot was retained by the French New Panama Canal Company as their technical agent during their dealings with the Interstate Commerce Commission at Washington, prior to the sale of the Canal Company's charter and property to the United States

A convincing tribute to Mr. Seurot's ability is his recent appointment as consulting engineer to the city of Montreal, to advise on the design of a tunnel under the Lachine Canal.

Mr. Seurot is a member of the Institution of Civil Engineers of Great Britain, as well as of both the American and Canadian Societies of Civil Engineers. The 1914 Gzowski medal is not his first success in this line, for it is recalled that the Institution of Civil Engineers awarded him a Telford Premium for a paper published in their Proceedings of 1912-1913.

Since the beginning of the war, Mr. Seurot has been a member of the Finance Committee of the Franco-Belgian section of the Canadian Patriotic Fund. He is attached temporarily to the French Consulate General at Montreal.

Wm. Norman Ashplant, city engineer of London, Ont., is now in training for over-seas service with the 33rd Battalion, in which he holds a commission. He was granted leave of absence by the London City Council from the beginning of December last. Mr. A. J. Brazier, Assistant City Engineer, has been appointed to act in the senior capacity during Mr. Ashplant's absence.

Mr. Gerald O. Case writes us from Victoria, B.C., concerning a paragraph published in our issue of January 27 in which it was stated that Mr. Case had been elected to membership in the Institution of Civil Engineers of Great Britain, and that he was the holder of several of the Institution's prizes. Mr. Case states that he has not been elected a Member of the Institution of Civil Engineers and that the only prize awarded him by that Institution was the "Miller' prize. The "Clarke" and "Society's" prizes were awarded him by the Society of Engineers, of whose Council he was recently elected a Member.

Mainly Constructional

East and West—From Coast to Coast

The City of Hamilton will shortly be advertising for a Deputy Chief Engineer.

Vernon, B.C., is putting in a sewage disposal plant and under-drainage system this season at a cost of $105,000.

A store and warehouse on Notre Dame Street, Montreal, owned by Mr. A. Lamy, was destroyed by fire last week at a loss of $200,000.

Toronto's high schools are overcrowded, and an investigation is being made as to the advisability of extending some of the buildings.

The Chatham, Ont., Council is taking steps to extend the water supply. As a beginning, a concrete dam, costing $20,000, will be constructed this season.

Plans have been completed for an addition to the General Hospital at Vancouver, B.C. The estimated cost is $75,000, and the architect is Mr. A. A. Cox.

The C. P. R. is purchasing interior fittings for the new hotel erected at St. Andrews, N.B., at a cost of $200,000. The architects were Messrs. Barott, Blackader & Webster, Montreal.

The London and Port Stanley Railway Company has applied to the Government for a grant to erect a new warehouse at Port Stanley, Ont., at a cost of $100,000. The plans

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*See report of the 29th Annual Meeting of the Society published in our issue of February 3rd.

for the proposed building show a structure one-storey high, 190 x 170 ft. in dimensions.

The survey of a route will be made shortly for a 10-ft. concrete roadway between Ottawa and Prescott, a distance of about fifty miles. The estimated cost will be approximately $10,000 a mile. The Provincial Engineer, Mr. W. A. MacLean, Parliament Buildngs, Toronto, has the work in hand.

The contract for the Rosedale Section of the Bloor Street Viaduct, Toronto, has been awarded to the Dominion Bridge Company at a figure slightly under $300,000. The length of the structure will be 580 ft. and the width 86 ft. It will consist of one steel arch span with a retaining wall 170 ft. long.

At West Vancouver, B.C., operations have been commenced on the installation of a waterworks system estimated to cost approximately $100,000. The work includes the construction of a large reinforced concrete dam and the laying of eighteen miles of pipe. The engineer is Mr. H. McPherson.

Messrs. Ellis & Connery, architects, Toronto, have dissolved partnership. Mr. J. A. Ellis has taken into partnership his son, Mr. C. H. Ellis, and will continue business in the Manning Chambers, Toronto, under the firm name of Ellis & Ellis. Mr. Connery has opened another office in the same building.

A section of model highway constructed with all the modern road-building appliances will be laid on the Toronto University campus during the International good roads convention next month. The work will be part of the programme arranged for the convention and will be complete in every way from foundation to wearing surface.

Mr. J. D. McArthur, the contractor for the Hudson Bay Railway, states that three hundred miles of the line have been graded, and that rails have been laid for a distance of two hundred miles. The grading to Port Nelson will be finished next summer, but the road will not be completed for eighteen months. Good headway is being made on the Port Nelson terminals.

A provisional committee has been formed in Montreal for the purpose of organizing a Metallurgical Association. The preliminary meeting held at McGill University was attended by several engineers and others interested in metallurgical subjects, addresses being given by Dr. Stansfield, the chairman, and Messrs. J. Carnegie, John Hardman and G. H. Duggan, and Col. Bertram.

The Toronto Terminals Railway Company are applying to Parliament for an act further amending Chapter 170 of the Statutes of 1906 by increasing the limit of bonding powers of the company, also empowering the company to acquire lands for, and to construct, provide, maintain and operate in the city of Toronto, freight and other facilities, in such manner and to such extent, as the business of the company renders expedient.

The provincial government vehicular and railway traffic bridge at Pitt River, B.C., now nearing completion, is said to have constituted a record on bridge construction in British Columbia. The first pile in the foundation work of the structure was driven on July 23rd last year, by the contractors Messrs. Armstrong & Morrison, and the whole work will be finished by the end of February. The structure will have cost in the neighborhood of $700,000. Mr. F. C. Gamble, Chief Engineer for the Province—who, it will be recalled, was recently elected President of the Canadian Society of Civil Engineers—has supervised this important undertaking.

In view of the extensive plans of the various Provincial Governments for building more and better roads, it is probable that in the immediate future there will be a revived demand for the necessary machinery. The province of Quebec, which is now taking a prominent part in this highway movement, is also able to supply the equipment essential for the making of good roads. At the Roads Congress held in Montreal, the exhibition of the General Car and Machinery Works, Limited, Montmagny, P.Q., was very complete. The officers have been identified with this branch of industry for many years, and are naturally keen in pushing goods made in this country. The company also are brass and iron founders.

Grading is now approaching the completion stages on the entire line of the Pacific Great Eastern Railway, according to Mr. J. W. Stewart, President of the company, who returned recently from a trip along the route as far as Fort George, the terminal, and the junction point with the Grand Trunk Pacific Railway. Mr. Stewart states that the contractors expect to have the intervening uncompleted stretches on the roadbed prepared for the rails by the end of the month.

The general contract for the bridge which the Burrard Inlet Tunnel & Bridge Company is to erect at Vancouver has been awarded to Mr. C. A. P. Turner and the Western Foundation Company. The proposed structure, which is estimated to cost the greater part of $2,000,000, will be of steel and stone construction, with a centre span of 225 ft. The engineers are Messrs. Cleveland & Comeron, Vancouver, acting under the direction of Sir John Wolfe Barry, Lyster & Partners.

Interesting details of Toronto's boulevard scheme are forthcoming from Mr. C. E. Chambers, Park Commissioner. Mr. Chambers says that the proposed boulevard will encircle the city for thirty-five miles and will make the finest driveway of its kind on the continent. In regard to the expenditure on the scheme, and its financing, Mr. Chambers makes the following statement: "the question of financing has been relieved since we have been successful in having the privilege of levying one mill for the next five years. Our expenditure will mean about two and one-half millions, but this secures nearly three millions, and since we are allowed to use money granted by the legislature for improvements in the future we will be able to develop immediately any newly acquired lands. It is our policy to buy all the land we need (936 acres) now. We will not let a parcel of land lie idle when public utilization calls for its use."

Obituary

Mr. Walter Strickland a well-known Toronto architect, died at Lakefield, Ont., on February 6th, aged 74 years.

At Winnipeg, last month, there occurred the death of Horatio M. Forrest, formerly locating engineer of the original survey for the C. P. R. and later government inspector of railways and district engineer on the Canadian Northern.

At Toronto, last week, there occurred the death of Ruliff Grass, a well-known dredging contractor who had carried out many large undertakings. The late Mr. Grass was a prominent business man and was connected with many enterprises. He was a Major in the 49th Hastings Rifles.

At Montreal, there died recently a well-known contractor in the person of John Ross who came to Canada early in life from Scotland. The activities of the late Mr. Ross were mostly in the way of railway work. When the Canadian Pacific Railway was started Mr. Ross carried out a great deal of important work in the Canadian Rockies. Upon the completion of the C. P. R. he went to Eastern Canada and carried out contracts on nearly all the principal railways east of Lake Superior. His firm built the Canadian Northern railroad, betwen Joliette and Quebec, also the Toronto-Sudbury branch of the C. P. R. His last important contract was for the Montreal and Southern Canadian Railway. The late Mr. Ross had done considerable Canal work in his time, including large contracts on the Welland Canal. His real home had been in Toronto for many years.

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Business as Usual? Then Let's Get After It

FROM time to time during the last few months we have pointed out the unique opportunity afforded public authorities, municipalities and private enterprise for entering upon constructional work, and it is noteworthy that our views are shared by those best qualified to make an expert estimate of the situation. In Canada one hears so much talk about the scarcity of money, and the prospective greater scarcity of money, that it is quite gratifying to find expression given to the opinion that great industrial activity will follow directly in the wake of the war. Indeed, it is rather alarming to be told that for **a period of eight years following the civil war in the United States, construction proceeded at such a pace** that a panic occurred. The panic in the States, however, was due, it appears, to excessive promotion of industrial enterprise, which has always been a weakness with our neighbors to the south of the line.

We find ourselves anticipating the period following the close of the war, when our real concern is what is going to happen during the period of the war. This rests largely with ourselves. The individual, be he **engineer, architect, contractor or supply man, can help** in this regard by disseminating confidence and bringing to bear all the arguments calculated to make an impression upon those with money to spend having an eye to constructional economy.

By united effort there is no reason why 1915 should **not be an average year for the constructor. There is** still money available for sound enterprise, but it can **only be liberated by a forceful presentation of facts bearing upon the low price of material, the plentiful** supply of labor, and the keenness of competition among contractors—which have all been enumerated **before.**

What can be accomplished in one branch of industry can be emulated in another. The furniture **manufacturers are organizing a campaign to induce** the farmers to buy some article of Canadian-made **furniture with a view to stimulating Canadian business in this field and maintaining employment in furniture** factories. Why should not the constructional interests embark upon comprehensive and well-considered schemes which would launch an active building **campaign into the channel of success? Certain it is that we shall never bring about any improvement in the** business situation by remaining within the narrow **confines of our offices and homes bemoaning the great and** lasting calamity which has overtaken us in the European war.

We subscribe enthusiastically to the policy of our **Chicago contemporary, Engineering and Contracting, which—be it noted in the editorial published in this** issue—gets clear out of the "Business-as-Usual" rut, **and clamours for "more public work than ever" this** season. Assuredly, now is the time to build: construc**tional materials will never cost less, all classes of labor** will never be so readily available, and there never will be a time when contractors are more genuinely anxious to cut their profits to the minimum.

Before passing to the remarks of our contemporary we must congratulate the public bodies of Canada on the excellent example they have set in providing for **constructional undertakings. The recent estimates** brought down in the House of Parliament show a **commendable policy of proceeding with public works,** while the road grants made by a number of provinces

—notably Quebec, which is entering upon the expenditure of another ten million dollars—are particularly encouraging. From the preliminary plans of the municipalities published in our last issue there would appear to be a fair amount of municipal construction in prospect, but it is hoped that this will prove to be only the skeleton plan upon which a substantial structure of civic enterprise will be erected.

In 1915 Let There Be More Public Work Than Ever

The U. S. Viewpoint as given by Engineering and Contracting, Chicago

WHEN any American City can sell $5,000,000 of 4 per cent. bonds at par "over the counter" in six hours, there is slight excuse for postponing public work. Not many cities have the wealth of Philadelphia, whose bonds were thus easily disposed of, and greatly oversubscribed besides, but money seeking safe invetsment is now so abundant that every municipality of sound credit can raise all funds, needed for public improvements. Nor has there been a time in many years when a dollar thus invested would secure so much effective labor and materials.

The manufacturer and the merchant may still hesitate about resuming "full blast," but solely because of uncertainty as to a ready market for the output. But a city having a need of improvements—better pavements, better water supply, better sewerage—has not to wait for a "market" for the better health and the cheaper haulage. Business men in charge of city affairs are not always quick to appreciate the difference between investing in goods that must be sold quickly and investing in a public plant that yields its services over a long period of years. In the latter case low interest rates and low prices for materials will give the maximum of benefit at the minimum of cost to the public.

Is this not an opportune time for local engineering societies to give added publicity to the great opportunity that cities now should seize? The money scarcity that the war caused six months ago has entirely disappeared. The labor scarcity prior to the war has —unfortunately for laborers—also disappeared. Not in 20 years have there been conditions more favorable for the construction of public works and plants of all kinds. Engineers know this, and realize the great economic opportunity. It is part of every engineer's duty to bring to public attention, as forcefully as practicable, the desirability of building now for the future.

Fortunately most cities are showing no indication of curtailing their normal expenditures for public works. But this, good as it is, is not good enough. There should be an abnormally great amount of public work done this year. Entirely aside from the desire to reduce the number of idle men, we advocate large appropriations for municipal, county, state and federal government improvement. Our advocacy of this rests upon purely economic grounds.

In recent lettings of public contracts, the number of bids has been very large and the unit prices have been low. Prices of structural materials will probably not be as low again in ten years as they now are. Laborers are willing to work with vim, and delays from strikes will not occur. For the individual or company having funds to invest in plant construction, 1915 will be a most favorable year.

Doubtless many will be far-sighted enough to act accordingly. The public has no economic reason whatever for failing to act vigorously in adding to the public plant—roads, streets, sewers, water-works, irrigation works, drainage systems, etc.

Had there been a period of inflation—a great "boom"—prior to last August, we should not now be urging investment in more plants—public or private. But for seven years the brakes have never been fully off the wheels of progress. The panic of 1907 cut the air pipe and set the financial brakes with a shock. Then came three years of gradual release and slow acceleration. Hardly had industrial momentum reached the normal when the "presidential year" again put the brakes on. The period of uncertainty as to tariff legislation had barely ended when the "great war" began. Also acting as a deterrent to progress in certain lines—notably railway construction—there have been "seven lean years" of hope from relief from extremely radical legislation. In another sense those were "seven fat years," years corpulent with attacks on the rates charged by railway and public service companies.

Looking back upon the period between October, 1907 and August, 1914, we see nothing that remotely resembles either the seven years prior to the panic of 1873 or that of 1893. During those no-panic years there was an enormous industrial expansion, and at the same time there was a most unsatisfactory currency condition—two features that made inevitable those great panics. Each of those two panics (1873 and 1893) was followed by the failure of thousands of corporations, the closing of banks, the foreclosure of mortgages, the sale of real estate for taxes, and all the sequent phenomena of extreme industrial debility. We need but to contrast those two real panics with the so-called "panic of 1907" to appreciate how slight was the financial illness seven years ago, and how slight the indisposition of the last seven months has been.

Recovery from great and prolonged fever is slow. Recovery from a touch of influenza is rapid. The panics of 1873 and 1893 were the commercial typhoids of those days. All subsequent troubles have been merely commercial spells of "grippe." And we may profitably carry the analogy farther. Just as nearly all municipalities have rid themselves of typhoid epidemics through the scientific sanitation that engineers have effected in the last two decades, so bankers and the government have scientifically eliminated most of the currency troubles and their consequent "fevers."

Other forces have also been active in America tending with equal effectiveness to eliminate conditions leading to severe panics. We refer to the forces that have been so frequently legislated against and so loudly and often unwisely damned—the "trusts," even to the "money trust." One effect of the numerous consolidations of capital in America has unquestionably been to reduce competition. Consider what that entails: First, a greater uniformity of prices and rates of charge; second, higher wages to the average employee; third, curtailment of excessive production;

and, fourth, reduction in the number of dollars invested in plant per dollar of annual output.

This last named effect is one not often spoken of, even by the trusts in their own defence. But it has been very evident to those of us who have done appraisal work for many corporations. It means that there has been a steady decrease in duplicate plants, plants built by competitors in excess of probable needs. Duplicate plants have nearly disappeared from the railway and public utility field. We still have, unfortunately, a good many duplicate telephone systems, but the great wastes of capital thus caused by unbridled competition are being steadily reduced. Reduced by whom or by what? by the "trusts," the consolidations of capitalists in each of the industries. While there is no real "money trust," there is certainly a publicity as to projected plants that, coupled with publicity as to earnings of existing plants, serves effectually to close the doors of investment bankers against many an unwise project that would have been easily financed fifteen or twenty years ago.

Whatever may be the defects of a monopolistic system—and there are many—certainly one of them is not overproduction, either of goods or of the plants that make the goods. The days of excessive building of railways, factories, etc., have almost vanished.

It is well to review these and other great changes that have occurred in America since the memorable 1893, for not infrequently business men, harking back to that "Coxey army" period, attempt to forecast simialr conditions whenever there is a financial flurry. "History," if bad, "repeats itself" only a few times, and then comes changes that make repetition impossible. This is particularly true of great disasters, for the ingenuity of men is aroused by ill fortune to prevent recurrence of it. Ultimately ingenuity triumphs. The great plagues of the middle ages are of the history that comes no more to civilized nations. The great panics have had their last staging. And, let us hope, "the great war" is the final act of the recurring tragedies of its kind.

This, then, is not the time to worry over the histories of '73 and '93, for those histories will have no future parallel. This is the time for every man—and particularly for every engineer—to urge the loosening of public purse strings wherever there are public improvements needed. Such action will be truly economic, and, besides, it will inspire similar action on the part of companies and individuals.

* * *

Will the War Cause Scarcity of Investment Capital and Depression?

MUCH is said by "economists" as to the vast destruction of capital now in progress and the subsequent ill effects to be experienced in the financial world. Capital is of many kinds and variously located. Most of it is not easily destroyed, even in a war area. Money is not destroyed by war, although it may leave its accustomed haunts. Crops may vanish in some places, but the soil and its most expensive improvements remain even in the very wake of wars. Railway tracks may be torn up, but roadbeds and right of way—by far the most expensive parts of a modern transportation system—remain. Roads and bridges suffer, but even in the very course of war must be maintained. Many factories close, but relatively few are destroyed. All this in the paths of battles, in the comparatively small areas of conflict. Turn to a map of Europe and note how insignificant an area of the warring countries has been scarred. Clearly, then, the destruction of the instruments of production —the "working capital' 'of these stricken countries—is an almost negligible part of the vast total. What war **does** destroy is lives, credit and business confidence; and of these only the first mentioned is a lasting loss. But even the lost lives of producers have a minor effect on subsequent industrial revival, for so long as men enough remain to man the industrial ship there need be no fear of general disaster or even general discomfort.

Writers on economics commonly speak of the current expenses of war as "destruction of capital," when the fact is that nearly all such expenses mean merely the diversion of human energy from peaceful pursuits to strife. To simplify the economic problem of war let us conceive a tribe of Indians living peacefully, some of the tribe idle, others engaged in making ornaments and implements, others in hunting, others in tanning skins, weaving, etc. Let war be declared between this tribe and another. Immediately there follow many changes of occupation. Less of ornament, less of clothing, less of certain food delicacies, less perhaps of needed food will be secured. More of bows, of arrows and of spears will be provided. At the close of the war the tribe will return to its accustomed occupations, its fields of chase and to the use of its skilled fingers and century-old knowledge, little altered by the conflict.

Complex systems of credit and instruments of modern production obscure the financial effects of war, and make temporary losses seem permanent or of long duration. The money spent for gun-powder would have been spent, let us say, for fine clothes. The iron that goes into shrapnel would have gone into plow shares. The war, in a word, has **diverted** production and has stopped progress, but the stoppage will scarcely last beyond the end of the war even in the warring countries.

"Yes," says the credit-broker, "but consider the vast war debt incurred by governments. Taxes will drain the gold of the producers for generations to follow." Here again is entire misconception of the after effects of war. A government debt is an obligation to pay. A tax is the means used to meet the obligation. But since both the creditors and those who pay the taxes are one and the same people—the citizens—it follows that no money capital is taken away from a nation that finances its war with money borrowed from its own people. For the most part, all along, severe wars are thus financed of necessity. There will be as great a per capita circulation of gold in France after the war as before. So, too, in England, Germany, and Russia. War taxes will be paid every year, and as fast as paid the money will return to those who originally loaned it. By them it will be invested. Whence comes the fear that money will be scarce after the war?

If we turn to the great American war, now half a century ended, do we find scarcity of money seeking investment at its close? Quite the contrary. In eight years following the end of the civil war, railway building and other financiering had proceeded at such a pace that a great panic occurred. The panic of 1873, like the panic of 1893, was due largely to excessive promotion of industrial enterprises—to "over production." A poor monetary system served to aggravate the ill effects of this "over production," but even the best of monetary systems could not have prevented hard times from "over production."

The psychological effect of a long war is not unlike that of a long winter. Peace, by its contrast, makes for a rebound of spirits, such as one feels in the spring of the year. Business men crave exercise of their talents, and the longer they have been compelled to hibernate the keener the desire to exercise when the storms are gone. So, too, the investor. And labor, having tasted the dregs of idleness, also rebels at further taste of it. So, when a long war ends, the industrial triumverate—manager, investor and employee—is at one in eagerness to work. Post-bellum days are days of industrial activity.

Improving the Status of Engineers—The Movement in British Columbia

In our issue of January 13th, we published an interesting paper, entitled, "Legislation and the Engineer," presented by Mr. G. R. G. Conway (Chairman, Vancouver Branch Canadian Society of Civil Engineers; Chief Engineer, B. C. Electric Railway) at the recent annual convention of the Victoria and Vancouver Branches of the Canadian Society of Civil Engineers. In the same issue, we commented editorially upon a phase of Mr. Conway's subject, our article being published under the heading "Would the Licensing of Engineers Raise their Professional Status?" We reviewed briefly the pros and cons of registration, and suggested that a discussion of such an important matter could not fail to be helpful. Mr. Conway himself takes the lead by contributing the following:

Editor Contract Record:

Referring to the editorial in your issue of January 13th, in which you discuss some points of the short paper which I contributed in December last, at Victoria, before the Convention of the British Columbia members of the Canadian Society of Civil Engineers, I should like to mention that this paper was merely an introduction to what proved to be an interesting discussion, which I regret was not fully reported. The general feeling, however, of the British Columbia members, who endorsed my views, was that it was better to concentrate our energies in obtaining Provincial Government recognition of the qualifications of corporate membership in the Society, rather than raise the larger issue of licensing at the present time, as our knowledge of the personal views of the leading members of the Government made us realize, that while they have been, and are willing to assist us along the lines indicated in my paper, they are opposed to every movement that suggests a close corporation such as medical men, the legal profession, or the land surveyors have in the Province.

Since the Victoria convention, a committee of the Vancouver and Victoria Branches has been received sympathetically by the Premier, Sir Richard McBride and the Executive Council of the Government, and after hearing our views they have promised to give them serious consideration. I am enclosing a copy of the memorandum which we submitted to the Executive Council at a meeting on January 26th, which will indicate to you the specific points our Branches are bringing before the Government.

If the members of the Society stand strongly together, I believe its status will be such as will give the members the greatest possible protection, and such united effort is also desirable in the public interest. The question of licensing, so far as British Columbia is concerned, it at present an utopian ideal, and we have therefore attempted to approach the question of improving the status of the profession in its more practical aspects, and hope for some measure of success. We are indebted to you for inviting a discussion upon the subject, as much educational work must be done even among our own ranks, before corporate membership in the Society obtains throughout Canada the full recognition that should come to it from Government and Municipal authorities. We must make our membership in the Society worthy of recognition by a public that regards our status with apathy, and the older members whose professional standing is secure should make some sacrifices for the benefit of their younger or less fortunate brethren. Although we may not all agree upon the best method of attaining our object, no one doubts that Provincial and Dominion Government recognition of membership in our national Society is an important step forward and will do more than anything else to convince all authorities who have to do with engineering work, both public and private, that in Canada we have engineers trained for every emergency. There is no necessity to go beyond our borders for engineering advice, unless special circumstances justified such a course.

In our proposals we have been anxious to cause no injustice to any qualified engineer practising in Canada, and for that reason we have proposed, in defining the word "Engineer" in certian specific Acts, that such a definition should recognize corporate membership in either of the three principal national civil engineering societies, viz., The Canadian Society of Civil Engineers, The Institution of Civil Engineers, and The Amercan Society of Civil Engineers. In the meantime we should encourage all members of the two last-named Societies resident in Canada to join our own national Society.

Yours faithfully,
G. R. G. Conway.

Memorandum Submitted by the Vancouver and Victoria Branches of the C. S. C. E.

January 26th, 1915.

To Sir Richard McBride, K.C.M.G., Premier,
and The Executive Council,
Province of British Columbia.

Sir Richard and Gentlemen:

This deputation represents the Legislative Committees of the Vancouver and Victoria Branches of the Canadian Society of Civil Engineers, appointed at the Annual Convention of the British Columbia members of this Society held in Victoria, December 12th, 1914.

After a full discussion the Convention was of the unanimous opinion that the Government should be approached with the view to the amendment of certain Acts, which deal more particularly with the work of the engineer in the design and construction of public works.

The Convention was of the opinion that this step was desirable, not only in the interest of the Engineering profession, but also necessary to the proper carrying out and control of public works, involving not only large expenditures of money, but the safety of the public both financially and physically.

The Convention had in view more particularly the following Provincial Acts:—Ditches and Water Courses, Drainage, Dyking, Irrigation, Municipal, Public Works, Railways, Sewage, Water and Public Health.

In view of the strong position in Canada to-day of the Society which we represent, embracing as it does practically all the qualified engineers in the Dominion of Canada, we are of the opinion that if the Acts above mentioned were amended so as to provide for the carrying out of all public works and also all plans and reports (prepared by private corporations for submission to the Government), by a corporate member of the Canadian Society of Civil Engineers, this recognition of the Society would constitute in itself a very desirable protection not only for the Government but for the public at large.

In view, however, that there are other qualified Engineers practising and employed in Canada who are connected either with the Premier Society of Civil Engineers of Great Britain, namely, the Institution of Civil Engineers, or are corporate members of the American Society of Civil Engineers, we believe that the suggested amendments should be comprehensive enough to include membership in these Societies.

We ask, therefore, that a definition be inserted in the "Interpretation Act" of the Revised Statutes of British Columbia, or that the above Acts be amended to provide that the word "Engineer," where that designation is employed in the several Acts, shall mean a corporate member of the Canadian Society of Civil Engineers, or of the Institution of Civil Engineers (of Great Britain) or of the American Society of Civil Engineers.

It was the unanimous decision at the Convention to use all the means at our command to obtain this recognition of our profession in as far as it is dealt with in the Public Acts of this Province.

We believe, however, that when the members of the Government understand the importance of our request, they will readily welcome the co-operation of the Society to attain this end.

(Signed) G. R. G. Conway,
Chairman, Vancouver Branch.
(Signed) D. O. Lewis,
Chairman, Victoria Branch.

On the Canadian Pacific's work at Rogers' Pass in British Columbia, the breaking of the American hard rock tunnelling record is becoming a regular monthly event. Not content with the remarkable progress of 817 ft. in November, and 852 ft. in December, the contractors, Foley Bros., Welch & Stewart, have established the mark of 932 ft. for the west pioneer heading during January. This is a performance which is likely to stand for some time. It indicates that the famous Alpine tunnelling records, generally considered unattainable in American practice a few years ago, are by no means out of reach. The Canadian Pacific's bore was through slate and the dimensions of the heading were 7 ft. 6 in. x 10 ft. Drilling was done from a bar which was first placed for the top holes and then dropped for putting in the lifters.

The report of Mr. C. N. Monserrat, the engineer appointed in January to examine the foundations of the Victoria memorial museum, Ottawa, has been presented to the Commons. He finds that the four walls of the east and west wings have settled five or six inches, and the walls of the main building from five to nine inches. He does not think that the stability of these walls is seriously affected, and states that apparently there has been no sinking for some time. He says, however, that the displacement of the main tower is sufficient to cause anxiety for its ultimate safety, and doubts as to its stability. The tower has now an outward inclination from the vertical of two feet, and is taking the main walls forward with it, opening up cracks which have already pulled out the steel beams of the fourth floor so that they have had to be supported with special girders. He does not think there is immediate danger which would make it necessary to close the building to employees and the public, provided the movement does not become more rapid.

In reporting Mr. F. C. Gamble's address at the closing sessions of the Canadian Society of Civil Engineers' recent annual convention at Montreal, we inadvertently accredited him with the following statement: "We submit that such a definition as we propose will work injury to any competent practising engineer," instead of "..... will **not** work injury ....." The sense of our report was apparent, perhaps, but it is well to call attention to the omission. Mr. Gamble's observation occurred in connection with the efforts that are being made in British Columbia to bring about a wider recognition of the engineering profession and obtain a legal definition for it.

Licensing as a Defensive Measure

THE activity of the architects in pressing laws for registration has brought up the licensing or registration of engineers in a new aspect, comments The Engineering Record. In Illinois, particularly, the question is acute, for there engineers are stopped from designing buildings unless they are also architects, and licensed as such, or have their plans approved or sponsored by a licensed architect. This evidently is an undesirable condition, though it has been tolerated in Illinois for at least 15 years. Sentiment in the architectural profession plainly is in favor of licensing, as was evident at the last convention of the American Institute of Architects. The report of the committee recommending registration was not adopted, not because of lack of sentiment in its favor, but because it was believed to be a matter for the consideration of the local and not of the national body. It is to be expected, therefore, that the number of bills for licensing architects will increase. Apparently, engineers must be prepared to meet the situation.

There are four courses open: (1) to do nothing, (2) to persuade the architects to abandon licensing, (3) to urge the general licensing of engineers, (4) to urge restricted licensing, to extend only as far as need be as a defensive measure. The first, inaction, will not appeal to anyone with pride in his profession, or a proper interest in his means of livelihood.

The second, to change the views of the architects, seems hopeless. It is to be expected that they will resent interference by engineers, despite the fact that they are the aggressors in placing restrictions on the free practice of the engineering profession.

The third course, general licensing of engineers, is more extensive as a defensive measure than is necessary. One does not oppose an army corps to a single regiment.

The fourth course, licensing of structural engineers only, thus meeting the condition imposed by the registration of architects but not entailing hardship on practitioners in other branches, is an adequate and justifiable course. And this, evidently, is the conclusion reached by the legislative committee of the Western Society of Engineers. The final conclusion of the society itself has not yet been reached. Some members are advising inaction; others a campaign to persuade architects to recede from their position. If the latter held hope of success, the Engineering Record, too, would advocate that course, for registration, it believes, does not accomplish the primary object of the law—the insurance of the safety and health of the public. That object can be more surely attained by supervision of designs and of construction. Moreover, undesirable men cannot be kept out of the profession by licensing, so that this argument fails to justify the law.

First and last, engineers must insist on their rights. The best measure to conserve them should prevail, and in the case discussed the Engineering Record believes that restricted registration—confined to structural engineers—is the best.

Winnipeg Armoury upon completion.

Winnipeg's New Armoury—Construction and Equipment

(Staff Article)

ONE of the large public buildings completed recently in Winnipeg, is the new Dominion Government Armoury, which is being erected at a cost of $520,000. This price is merely for the erection of the building and does not include the cost of any furnishings or equipment.

The ground space occupied measures 205 x 317 feet, and the height is two storeys, with full basement. From each corner of the building, there arises a tower, three storeys in height, with full basement.

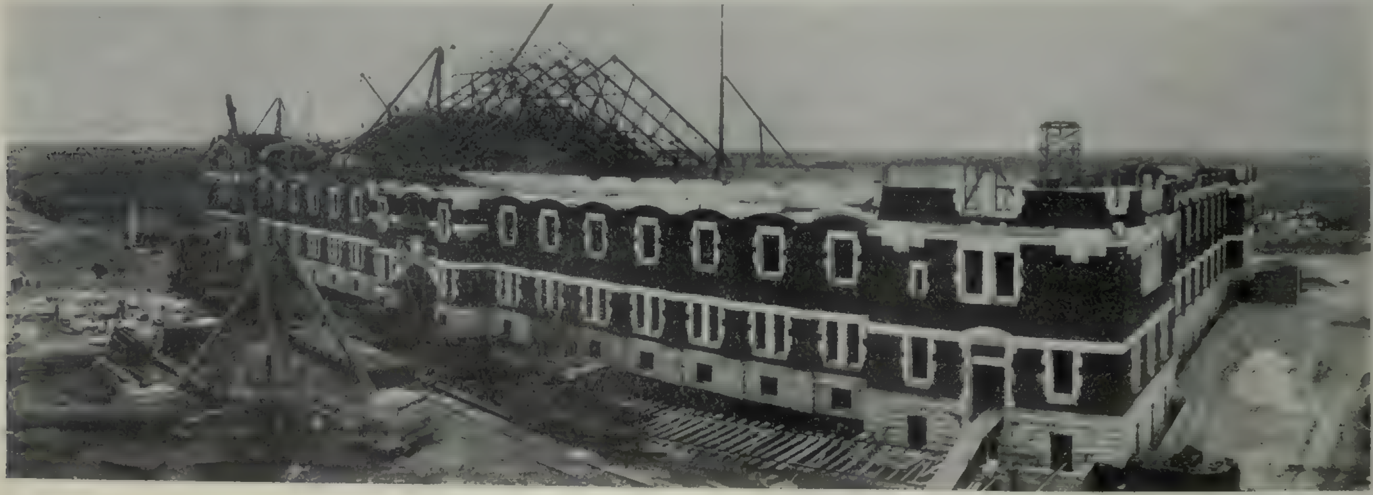
The construction of the building is wood joists and steel beams. The outside walls are 26 inches thick and are built with Rustic faced brick with stone trimmings, with an interior backing of sand-lime brick. The centre of the building which is 126 x 238 feet in area, is to be used as a drill hall. This space extends the entire height of the building and is surrounded by a balcony on the first floor.

In describing the various features of the Armoury, it is necessary to start with the basement and work up to the four towers.

The basement, which is 12 feet high, contains many interesting features. The floor is of concrete, with a covering of mastic. There are fifty-two bowling alleys provided for the men, four for the sergeants, and four for the officers. Two rifle ranges have also been erected on this floor. For the storage of equipment, twenty-five rooms have been provided. These are situated on each side of the room. There are two large toilet rooms, one at each end of the basement, containing the usual conveniences—including a shower bath in each. Three large battery gun rooms, 28 x 56 feet, and three wagon rooms, 28 x 30 feet, are situated in the basement.

On the ground floor there is a drill hall which measures 126 x 238 feet. The walls enclosing this area are a special feature in the construction of the building. They have a thickness of 44 inches, and are faced with face brick. The floor of the drill hall is of reinforced concrete and steel construction, faced with a covering of mastic 1½ inches in thickness. On this floor there are sixty-two company rooms, each room measuring 14 x 32 feet.

On the first floor there are an additional thirty-two company rooms, surrounding the balcony enclosing the space occupied by the drill hall on the ground floor.



Winnipeg Armoury under construction. Note the huge steel trusses.

There are two large mess rooms on this floor, one of which measures 112 x 23 feet, while the other is 96 x 23 feet. The Lecture Room is 40 x 30 feet. On this floor there are two toilets. A special feature of the interior trim is that all of the corridors have asbestos dados. The interior trim throughout the building is of oak.

Four towers are situated, as seen in the illustration, one in each corner of the building. Their size is 35 x 35 feet, inside measurement. The caretaker, who will have his quarters in one of these towers, has been provided with excellent accommodation, his apartments consisting of four bedrooms, living room, kitchen, bath and toilet. The remaining three towers will be used as storage rooms. In each tower there is a cast-iron stairway. All the floors are of maple.

The building is lighted by lantern windows, there being forty-five steel windows on each side of the Armoury. Six huge steel windows—one 18 x 22 feet and two 18 x 18 feet—built at each end of the building aid in the lighting of the drill hall.

The main roof over the drill hall floor is carried by sixteen steel trusses having a clear span of 126 feet, the weight of each varying from 14 to 18 tons. These trusses are seen in the illustration showing the building under construction. The trusses used in this building are the largest in Winnipeg.

A one-pipe circulating system, of low pressure steam heating, will heat the building. There are three boilers, each 72 inches in diameter and sixteen feet long. The boilers are faced with white enamel brick and are laid on a concrete foundation 12 inches thick. The number of radiators apportioned to the various floors is as follows:—Seventy on ground floor, forty on first floor, sixteen on second floor.

There are eight radiators in the main hall. These are of an extra large type, being four coils, 38 inches wide, and twenty-four sections, having a total area of 1,536 square feet. Under the balcony there are twenty-two Ontario wall radiators, each having eight sections, the total area being 1,584 square feet. The heating pipe surrounding the lantern light is 484 feet of 4-inch W.I., and has an area of 568 square feet. Two multiblade single width feed housing fans ventilate the building.

The Armoury is wired for 750-60 watt incandescent lamps, suitable for the voltage supplied to the building. There are 285 switches, and three 1/8 h.p., two 3 h.p., two 5 h.p., and one 7½ h.p. motor outlets.

The main items in the list of quantities used for the erection of this building are:—4,000,000 common and faced brick; 30,000 cubic feet of stone; 1,000,000 feet of lumber; 30,000 yards of excavation; 1,000 tons of steel.

It was appropriate that the Canadian Minister of Militia should honor Winnipeg by performing the opening ceremony of the new armoury. The building will be occupied by troops who are training in Winnipeg.

The general contractors were Messrs. Carter-Halls-Aldinger, Limited, of Winnipeg, while the architect was Mr. Herbert E. Matthews, also of Winnipeg.

A highway for motor trucks, which is to be constructed between Los Angeles and the harbor, a distance of 24 miles, is to have a width of 35 to 40 ft., and a concrete base of sufficient thickness to withstand the wear of the heaviest motor traffic. The cost will be approximately $30,000 per mile, or three times the cost for the ordinary paved highway in this district.

The Timber Question

(The Building News, London)

THE question of the supply of timber is becoming a serious one, as the stocks now in hand are diminishing fast, and the arrivals of the timber that reach us in ordinary times from Finland and Russia must for the time, stop until something is done with the Germans, who now control the the exit of the Baltic. The ports facing the Skager Rack, Christiania, Frederickstad, Gottenburg, and others from which the best timber is shipped, hesitate to ship cargoes which must run the gautlet of the mines.

The yellow and whitewood of Sweden, Finland, and Russia have been our main stay and backbone of late years; Sweden, above all, has cut timber of all sizes to suit our markets: the battens, deals, and planks for joiners' work, the varying sizes used for timbering in houses, from the slate and tile battens to the 2 by 3 up to 12 by 4. The Christiania and Frederickstad consignments are the finest, and of the first quality that the world produces, though many of the Russian deliveries are good, the St. Petersburg and the best Gefle especially being very hard and clean.

If the supply is to stop from these countries, we must look farther afield. The freights will be higher, but may not, if the timber is bought at a reasonable price, send prices higher than are now asked for Swedish and other wood, the cost of which at the moment is almost prohibitive for ordinary building. The doors, sashes, and frames, and other joiners' work, including that for horticultural work, such as sash-bars, rails, stiles, etc., can now be produced by English joinery works almost as cheaply as those imported; but, of course, the joinery works will have to buy timber at higher rates.

Some of our Colonies can supply any amount of timber—pitch pine, Australian redwood, and other softer woods. At the Colonial Exhibition many years back a very large variety of wood was exhibited which won praise from all. Take the Australian redwood, which has been so largely used in this country for road-paving; this is very free from knots, sap, and similar defects, but it is heavier than the Swedish wood, though we do not think it exceeds that of Gefle. Of course, the freight would be greater; for timbering purposes it should be a good substitute. Russia has enormous forests of fir and similar timbers in Siberia and bordering the Trans-Siberian Railway, if she can get them to us; while on the White Sea very fine deals and planks are shipped in ordinary times from Archangel and Onega.

A substitute for fir joists, where it is not a question of price, and a good substitute, would be the fire-resisting floor of steel joists, say, 2 ft. to 3 ft. apart, with concrete of cokebreeze and cement filled in between, brought ½ in. below the bottom flange, and above the upper one with a thin bed of cement and sand to render the upper surface level, then a thin bed of asphalt, and a parquetry floor or a pitch-pine one laid on that; or one of the patent pavings of imitation mosaic or a similar kind of finish in a compound of cork and colored cement. The ceiling under would want only two coats of plastering, and would not require to be lathed. The absence of laths and wood joists would do away with the cracks so often seen in ceilings if the two coats of plastering were done in well-matured material, and the setting coat has the moisture well-trowelled out of it to a hard surface. This floor should be nearly soundproof, and very firm to walk on—unlike the floors laid on fir joists, that shake half the furniture as you walk.

The ground floor could be of cement-concrete, similar to that described to be laid by the local authorities over the site. This floor would only need the 6 in. of cement-concrete with the thin coat of asphalt and wood block, or either of the other floors already mentioned. Floors of the kind described would lend themselves well to square carpets of Persian or Turkish or Indian make, or even mats of similar kind.

Many of the casements could be of wrought iron, such as have been made for the last fifty years, of artistic design, and with up-to-date fastenings. With the floors described, and the casements in wrought iron, roof-timbers of pitch-pine or Australian redwood, doors of pitch-pine, lintels of rolled steel, little fir timber would be wanted until the trade is in full swing again.

There are, of course, many countries that have large forests of fir, but labor in them is so much more expensive; and besides, there are not the facilities for getting to ports, or sawing it to the required sizes, and the cost of freight is so much greater. Much of the timber lately imported is not really fit to use. It is very clean and bright to look at; but it ought to have twelve months' seasoning in the docks before it is worked, or else be dried in hot-air chambers; but "Needs must when the —— drives."

Concrete: A Medium of Aesthetic Expression*

By Irving K. Poud, F.A.I.A. Chicago

Mr. Irving K. Pond.

AT the forty-first convention of the American Institute of Architects, held in November, 1907, I reported, as chairman of the then existing committee on Applied Arts and Sciences, upon the possibility of concrete in the field of architectural expression. Much of the matter, which I then formulated with the assistance and approval of the other members of the committee, is altogether applicable to the subject to-day. The introductory sentence was as follows: "Although the exact relationship existing between concrete and steel reinforcement under a given condition is yet to be accurately determined, and the structural use of reinforced concrete is yet to be reduced to an exact science, and although the manipulation of concrete and its application to structural uses has not as yet become an art, yet the fact that in its use and treatment there are immense scientific and aesthetic possibilities brings the subject of reinforced concrete well within the field of study of this committee, especially at this time when the general topics of steel structure and concrete reinforcement are before the Institute for discussion." The science during the years which have elapsed since that was written has possibly become a bit more exact, engineers have been at work—many formulae have been developed, many tables have been compiled, and much has been gained in the way of practical experience. This practical experience has been of benefit in developing the art of manipulation, for Art consists in "doing"; but the art of design seems not to have kept pace. It is to stimulate that art, and to awaken in the architect a realizing sense of his opportunities and responsibilities that I then entered into the discussion and now continue it. It is essential throughout such discussion to keep clearly in mind the true and abiding status of architecture and the architect. The architect is not a mechanical fabricator of mathematical diagrams. His highest concern is with the ideal, and his first sketch should present an idea, an idea which is conceived in beauty. The past has demonstrated that architecture as the expression of the ideal can materialize in but one or the other of two great manners: that of the articulated structure, unit added to unit, and that of the plastic mass. The most noble development in the first manner is in the architecture of masonry (brick or stone), and this development has reached its logical limit; in no way except, may be, in mere size, its least noble attribute, is it to be excelled. Under the vital art of this first manner lay an intuitive science; under the too transient beauty of the work of the second great manner lay nothing of science at all, and so this architecture has well-nigh vanished except as some adherence to the principles of the first manner has interposed to save. And now comes the ghost of what might have been and calls for an incarnation, feeling (if a ghost can feel) that in reinforced concrete science is preparing a body which can be vivified with the spirit of art. If this feeling is substantiated, to the architect is opened up a new range of possibilities. The architect becomes in a sense a sculptor, a moulder of monumental mass, not the fantastic figure, who, at first, with sharply insistent blows, and then with infinite persuasive tappings, releases the form imprisoned in the block, but a creative constructor who builds up his ideal and shapes it by the irresistible, though tender, moulding of mass and form. In this the architect assumes no new function, but develops that feeling which by nature and of necessity inheres in the architectural mind. The vital difference between the sculptor and the architect is that the former is bound by no necessity for expression in structural terms; mass and form being enough for him; while the architect, if he really is to be an architect, must have structural laws ever in mind, and must make his work an interpretation of these laws and a symbol of their aesthetic value in the expression of the higher ideals of his race and time. The architect as well as the sculptor revels in this feeling of mass taking form under his skillful manipulation; and the feeling for plasticity and for mass in flux is potent in the true architect, even though he be designing in the most refractory medium a masonry-clad steel skeleton. In most of his work the architect has to content himself with an intellectual substitute for real feeling, and his conscious delight is rather intellectual than emotional as the idea takes form in the sketch and in preliminary plan and elevation. His fingers may itch, they do itch, to feel the flow of the mass, but the feeling remains abstract and intellectual. Therefore certain architects, if not indeed the architectural body-general, are viewing with keen interest, when not actively aiding, the development of the possibilities of this fairly new and altogether plastic medium, reinforced concrete; a medium which really does flow and is moulded, and through which the form appears in gracefully unfolding stages, till the final mass stands revealed, a veritable unit. One cannot in thought connect with this materialization the shock of unloading beams, the rattling musketry of rivetting, the petty and fussy application of fireproofing and surface coating. In fancy, as almost in fact, the architect sees the flowing mass take form under his own hands.

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* Paper presented at the Annual Meeting of the American Concrete Institute.

Though the use of concrete goes back into antiquity, plastic architecture would seem to be in the veriest infancy, and would seem also to be asking the genius of this age to give it perfect expression and make it worthy to stand with the architecture of the past and the yet-to-come. Though the past be examined for precedent, little will be found. Rome used concrete in bulk—but undeniable evidence of a scientific use of the material is wanting. Rome applied superficially the arts of other times and countries, but of itself left to posterity only monuments expressive of a highly temperamental force, breathing little or nothing of spirituality. Persia covered with stucco or veneered with beautiful tiles her masses of crude masonry. The Arabians and the Moors expressed their emotionalism in a plastic architecture decorated with a skim coat of ornamental plaster or an incrustation of tile, intricate in pattern and beautiful in color. The concrete of the mass was but mud, and the science of building was unknown. In such material beautiful day dreams were realized only to crumble when the spell was past. The Spanish missions were built with rare feeling for mass and light and shade; but feeling swayed and science did not guide. With the science of to-day to guide and the art experience of the past to illumine, into what logical, noble and beautiful forms should not concrete shape itself, to the end of an enduring, spiritualized architecture.

The possibilities, even the aesthetic possibilities, within the range of reinforced concrete construction can hardly be over-estimated. Little beyond the introductory chapter has been written in the history of reinforced concrete, and every advance in the science of its manufacture and use will signal an advance along the line of artistic application.

Except in well-defined types, designed to serve certain well-defined uses, it is impracticable so to carry masonry construction beyond and behind the facade as to result in a homogeneous structure—wanting which architecture becomes but a hollow sound. The architecture of a reinforced plastic material may, and logically will, express itself throughout the entire structure to the remotest core. The unity, the truth, the harmony of the whole may in every part be manifested. Therefore, again, the possibilities inherent in concrete present themselves alluringly to the architect to whom the art means as much as does the science of building.

The architectural brain is not so congested by the weight of pregnant thought that at a blow a Minerva shall issue forth full fledged and full armed. That is not the history of the evolution of an architectural style. It will take time and struggle, and developed artistic perceptions in this, as in former cases, to reveal the possibilities of beautiful and of monumental design.

It may well be conceived that a moulded architecture, so to speak, an architecture of flowing and harmoniously interrelated masses, may not appeal immediately to the architect ho has been taught that his art consists in naively piling up child's building-blocks on a large scale. Whatever may be urged against the deadly dulling practice of following the line of least resistance in architecture, certain it is that a material in which it is easier, as well as more logical, to fashion new and appropriate forms than to follow cut and dried conventions can not be regarded as other than a vivifying factor in a possible architectural development, and its advent hailed with delight. When architects relieve themselves of the notion that monumental architecture, for example, consists solely in a row of classical columns superimposed upon a basement, it will be a wholesome day for the art they profess to practice. Probably ignorance, inability and self-distruct in the architectural ranks will remove to some more or less remote future the development of a monumental architecture expressing itself in new forms fashioned in new materials. Yet it is possible that, in this, as in other ages, commercialism, itself so devoid of aesthetic tendencies, will pave the way to the realization of an aesthetic ideal. A material which holds in itself the qualifications for commercial use will in that very use reveal its aesthetic possibilities. No material which puts into the hand of the architect power to produce permanent mass and form, and add the enrichment of light and shade, color and texture, will long be ignored when science has made its use commercially possible. It would, then, seemingly remain only for science to demonstrate the practical value of reinforced concrete, in respect to its physical properties, and art must unfold whatever it holds of beauty.

The steel skeleton developed from commercial necessity, and to clothe and protect that skeleton, the architect, naturally, used whatever means lay at his command; stone, brick, terra-cotta, and metal were called into requisition. To clothe the skeleton in one or another or all of these materials became a fixed habit with the architect. So that when concrete came into use, not only was it ignored as a possible clothing for steel, but when the skeleton of reinforced concrete was set up it was itself clothed after the existing fashion for steel. Such is the fatal force of habit! Granting to concrete the qualities ascribed to it, that it is fireproof, that it may be rendered moisture-proof, that once in place it is not affected by atmospheric and climatic conditions, that it can be permanently colored, can be moulded and chiselled, that it can be formed in place and need not be applied piecemeal—what better material could be sought for clothing the steel skeleton—and why the need of any cloak at all to such material when it has been treated with any manner of decency or respect by the designer? So aesthetically there would seem to be unlimited possibilities in reinforced concrete.

It is not inconceivable that ornamental terra-cotta and tile, beautiful in color and texture, and also sculptured stone will be called upon to embellish and distinguish, though not is any manner to clothe or conceal, the concrete structure. The presence of these materials may be needed as a saving grace in these early days of design in concrete, to save the designers from a too brutal conception of the forms they deem the material must necessarily take. This is an unfortunate, though marked tendency now, in what should be a refined and restrained domestic architecture, to shape concrete, and its lath and plaster imitations, into the crude, though characteristic, forms of the old mission work. It is needless to say that these forms have no meaning outside of their original environment and would not have existed there but for the exigencies of the case—the crude nature of the materials procurable and the absence of all skilled labor.

But to-day, with art and science co-operating, it would seem as though architecture were on the verge of an awakening. Commercial architecture with us is beginning to feel the thrill. Abroad monumental architecture as well is showing signs of a renewed joy in life, and structural concrete, both of itself and embellished with richer materials, furnishes the new and seemingly adequate medium of architectural expression.

Much of this was written, as I said in opening, some years ago. Looking back over these years it does not seem that there has been an advance in the aesthetic field as opportunity seems to have offered, or as might have been expected. But we cannot lay this backwardness altogether to the manipulator of concrete nor to the architect. Economics may be a factor, but it could not be a controlling one in a community which had the desire and will to advance in the art of self-expression which the art of architecture pre-eminently is. I know the time is not ripe for a finished and full expression for the community or the national life is not unified and complete; but there are qualities under the surface—refined and human qualities—which might at least find an echo in our concrete structures. Perhaps the echo is being heard, faintly at least. I sometimes think so but with you all I desire the day to hasten, not only when architecture in concrete or otherwise shall express us, but when we shall have better selves which will demand and receive an interpretation in architecture.

The Use of Electricity in the Manufacture of Portland Cement*

By Malcolm McLaren†

THERE are few industries in which the cost of power represents such a large percentage of the total cost of production as in the manufacture of Portland cement. Any means, therefore, which may be employed for reducing the amount or cost of this power must receive most careful consideration. A great deal of attention is being given to the development of more efficient methods of grinding, and while these efforts should be encouraged, the writer's experience indicates that the amount of power required to produce the same quality of cement varies little with the different types of grinding machines in common use, when given equally intelligent supervision. It is also believed that in no way can the cost of production be more materially reduced than by the extensive use of electric drive.

In the process of manufacture the cement rock is brought from the quarry to crushers, which break it up into pieces three or four inches in diameter. Then it passes into drivers where all moisture is removed, then to the pulverizing machines, and then to the rotary kilns. The pulverized stone is fused in the kilns, and comes out in the form of hard clinker balls averaging about an inch in diameter. This clinker is then ground to the desired fineness of finished cement and delivered to the store house. Fuel is furnished to the kilns in the form of pulverized coal and this must be prepared at the mill. Elevators and conveyors are used for transmitting the material through the works. A relatively small amount of power is required in the stock house for operating packing machines and in the machine shop, and in some cases also for air compressors, hoists, and pumps.

In most of the earlier cement mills, which were of comparatively small capacity, all the machinery was driven by steam engines. The power house was placed between the raw stone grinding and finishing departments, a separate engine being employed to drive each side. Various methods were used for driving kilns, coal pulverizing machines and other parts of the mill, which often involved complicated transmissions or long steam pipes. The obvious adaptability of electric power for the operation of these outlying portions of the mill first led to the introduction of motors for cement manufacture.

As mills increased in size it became more difficult to operate one department from a single engine without considerable complication in the drive and attendent loss of power. Also the single unit drive involves considerable loss in production due to the necessity of shutting down the entire department when any change is required in the machinery. Attempts have been made to minimize such delays by using clutches for the eontrol of ths individual machines, but these have not proved sufficiently successful to come into general use. In many cases, therefore, motors are now being used for driving the main grinding machines. Sometimes these are employed simply in extensions or for driving the machines more distant from the power house. In other cases the entire mill is operated electrically. Thus there has been a gradual enlargement in the field of electric operation until now it is a comparatively easy matter to demonstrate the advantage of such a drive for an entirely new mill. For an existing plant, however, it is more difficult to determine whether to abandon perfectly serviceable steam engines and mechanical transmission in order to obtain the advantage of electric operation. There is also the still broader question, applying to both existing and contemplated installations, as to whether the cement company should produce its own power or purchase this from a public supply company. It is the object of this paper to discuss briefly some of the elements which enter into the solution of these problems.

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* Presented before Section D of the American Association for the Advancement of Science at the Philadelphia Meeting.

† Professor of Electrical Engineering, Princeton University, Princeton, N.J.

Considering first the case of an existing steam-driven plant, for which it is proposed to substitute new steam units, generators, electric transmission and motors. It might appear at first sight as though such a change could not be justified as steam is still to be used to generate power, which is now applied in a more direct manner. The saving under the new arrangement, of course, is largely due to the improvement in steam economy in the high speed turbine sets used with electric drive over that of the engines they replace. The problem reduces itself to the question of whether the contemplated change will reduce the cost of production sufficiently to cover the overhead charges on the new apparatus and show a fair margin of profit on the capital invested.

Cost of Installation

In order to figure the cost of the new installation it is first necessary to decide upon the method of drive, especially whether to employ one motor for each grinding machine or for a group of machines. The arrangement and type of apparatus will largely determine this matter. If a vertical driving shaft is used on the grinding machine an individual motor may be advantageously employed, for this avoids a twisted belt with a consequent saving in maintenance both for the belt and the bearings. Individual drive gives the maximum flexibility in operation but increases both the first cost and the maintenance of the electrical apparatus, so that some grouping of the machinery is generally advisable. The question of whether to use direct or alternating current reduces itself almost entirely to a matter of first cost, which is in favor of the alternating current system. Either type of motor will satisfactorily do the work, and there should be little difference in the cost of maintenance. The proper capacity to use for motors can usually be determined from the company's records or from the machine makers. The generator capacity can be best determined from a test on the existing plant. With these data at hand, the cost of the new installation may be readily estimated.

Taking up next the comparison of operating costs, it will be found that cement companies usually keep accurate records of all items entering into their power costs. These give no indication, however, of the amount of power developed, and this must be known in order to estimate the cost of power under the new conditions. As the load is not subject to wide fluctuations, it is possible to make a close determination of the average power consumption from a carefully arranged twenty-four-hour test, during which the total quantity of steam changeable to power development should be measured and indicator cards taken at frequent intervals on all the principal engines. If there are any small engines a few cards should be taken upon these or their load estimated from the character of their work. At the same time the output of cement should be carefully noted. It is important that during the test the mill should operate under normal conditions, both as regards the machinery in service and the character of the material being ground. Then the measurements upon the steam and cement output give the quantity of steam required per barrel under existing conditions, and the power records and output give the corresponding power consumption per barrel. The power required under the new conditions will be the same as before, except as modified by the difference in efficiency of transmission, which is usually slight, and may be neglected except in extreme cases, or when great accuracy is desired. Knowing the power per barrel, the quantity of steam per barrel under the new conditions may be obtained from the turbine makers' steam guarantees. Having then the quantity of steam under the new conditions, and the quantity of steam and itemized cost of power under the old conditions, it is a simple engineering problem to determine the cost of power under the proposed arrangement, and show the saving which may result from the change. When making this comparison consideration must be given to the fact that the increased flexibility of motor drive will reduce delays in the mill and thereby increase production. It also may allow some re-arrangement of the mill machinery, with a consequent reduction in operating cost. While the above method of investigation may appear somewhat complicated, it is believed that all these matters must be duly considered in order to reach any proper conclusions.

Turning next to the question of whether such a cement company should equip with motors and purchase power from an electric supply company, the same general procedure may be followed, though the investigation is simplified now, as no steam measurements need be made, and the cost of power may be derived directly from the supply company's rates when the amount of power per barrel has been determined from test. In this case the losses in the generation of power, which may amount to 10 per cent. of the total load, will be saved to the cement company. On the other hand, transformer losses amounting to about 3 per cent. must be added, unless power is delivered at a voltage suitable for mill operation. Also, under the new conditions, the mill output should be increased, owing to more uniform drive, for with the close regulation of a large supply system, the speed of the mill machinery may be maintained near a desired maximum, while in most cement mills which generate power, the speed drops frequently on account of low steam pressure, low vacuum or overload on the engines. Many companies which have changed over to purchased power, testify to a marked increase in output due to this cause. They also find that when their superintendents are relieved from maintaining their power equipment they are able to concentrate their attention upon production with beneficial results.

Granting then that the cement company may derive certain advantages by purchasing power, the question naturally arises, whether the supply company will obtain any corresponding benefit from the transaction. This will depend upon the character of the load, the cost of production and the amount of energy to be supplied. The ideal load for any supply company is one which is constant throughout the year, or, in other words, which has a load factor of 100 per cent., but most companies consider themselves fortunate if they can reach a load factor of 40 per cent. The cement load, on the other hand, approaches this ideal as closely as in any industry, for it varies little, day or night, summer or winter, often maintaining a load factor above 80 per cent. for months at a time.

The cost per unit at which power may be developed in any locality varies considerably with the total output of the plant producing it, for the capital cost per kw. for buildings, turbines, generators and practically all parts of the system decreases as the size increases. Also, the operating cost diminishes on account of improved steam economy and general efficiency of the apparatus, lower cost for attendance, supervision and maintenance, and the opportunity of locating the plant more favorably with respect to cheap coal and water supply. There may also be the opportunity of obtaining power from a hydro-electric system which may result in a still further reduction in cost. The question then of whether the supply company can produce power more cheaply than the cement company is largely a matter of the relative size of the two installations. This leads to the consideration of the volume of the cement load. While this, of course, varies in different localities, some indication of its magnitude may be obtained by considering the eastern Pennsylvania district, which supplies this market. Here, in a narrow strip of territory less than 20 miles long, the total output exceeds 60,000 barrels of cement per day, and while the load on the individual mills varies from about 1,000 kw. to 5,000 kw. if the power were supplied from one central station the load would reach approximately 50,000 kw., with a daily output exceeding 1,000,000 kilowatt-hours.

It is not surprising, therefore, that the cement companies throughout the country are changing over to the electric drive at a rate that should soon cause the steam-driven plant to be looked upon almost as a curiosity.

Stopping Water Fissures by Crouting

DIRECT injection of cement grout into water-bearing fissures as a means of checking or stopping the flow of water into shafts and tunnels has been experimented with for a decade or longer, and seems to have been first attempted in Europe. It s only lately, however, that the process has been entirely successful. This success has been accomplished on the Catskill Aqueduct, now under construction by the city of New York. This aqueduct includes a number of deep pressure tunnels, reached by shafts for both waterway and construction purposes. In some portions of these shafts and tunnels, considerable underground water was met. The contract for the first of these tunnels was on a section known as the Rondout siphon. It leads under the Rondout Valley at a depth of from 400 to 800 ft., and is about five miles long. The engineers expected that considerable water would be encountered; but fortunately this was not the case, except at one shaft, known as No. 4, which penetrated the rock at a junction between limestone and conglomerate.

Water-bearing fissures were encountered almost immediately. At a depth of about 200 ft., a flow of 1,500 gallons per minute was struck. The shaft then contained as many pumps as could be used, and it seemed impossible to sink it further. After vain efforts had been made to proceed, John P. Hogan, a division engineer of the Board of Water Supply, suggested that a cementation of the fissures be tried. The process is described by Francis Donaldson in a paper read before the American Institute of Mining Engineers.

Since the shaft was partly full of water, it was necessary to drill holes with a diamond drill. Platforms were placed on the timbers at the water level; the diamond drill was installed; and six 90-ft. holes were drilled in the bottom of the shaft. Several carloads of cement were pumped through these holes into the fissures, the drill casings being used for grout pipes. This largely cut off the flow of water from the bottom, and sinking could then proceed. After that, water-bearing seams were grouted as soon as encountered, and the contractor was able to finish the shafts and tunnel within the contract time. Shaft No. 4 was a rectangular, timbered construction shaft with no concrete lining; consequently it was impossible to cut off any of the water coming in from above the point where grouting was first attempted. On this account large volumes of water had to be pumped until the tunnel was finally sealed.

At the next wet shaft the writer had to do with, advantage was taken of the experience gained at shaft No. 4. At this second shaft, No. 4 of the New York City siphon, good progress was made until a depth of about 100 ft. was reached. The first hole drilled in the bottom below this depth struck a stream of water; the flow amounted to about 150 gallons per minute. This was plugged. It was found that each of the twelve holes in the sump cut encountered the same stream of water.

As soon as each hole cut the water-bearing seam, it was plugged with a tapered wooden plug. After all the holes in the sump had been drilled and plugged in this way, the ground connections were made one at a time, so as to restrict the flow of water into the shaft. Each connection was made with a piece of 2-in. or 2.5-in. iron pipe about 3 ft. long, threaded at one end and given a long taper at the other. The tapered portion was made rough on the outside by nicking it with a chisel. A heavy iron stopcock was screwed to the pipe, the tapered end wrapped in several thicknesses of burlap, the wooden plug removed from the drill hole, and the tapered pipe driven in, the stopcock being left open. This was the most exciting and the wettest part of the job. After the pipe had been driven in hard, the stopcock was closed. In this case connections were placed in all the wet holes before grouting.

The grouting machine or tank used on the aqueduct was operated by means of compressed air. It is built like an air-lock, with a door on the top, through which cement, sand, and water are introduced, and has a 2-in. discharge opening in the bottom, and air-connections top and bottom. The discharge opening is connected to the grout hole by a heavy rubber hose. Another 2-in. stopcock is placed at the outlet of the tank, and a 2-in. by 1-in. tee is placed between the hose and the cock attached to the pipe in the drill hole. Into the side opening of this tee, a 1-in. stopcock is screwed.

The machine is installed at the bottom of the shaft, and is connected to one of the holes and also to the high-pressure air supply. The 2-in. stopcock on the machine is closed, and the other is opened. The door in the top is opened, a sack of cement, three or four buckets of water, and (if the cavity to be filled is large) a sack of fine sand are poured in; the air connection at the bottom is opened, and the air allowed to bubble through and mix the grout. Then very quickly the door is closed, the lower air-connection is closed, and the discharge-connection and the upper air-connection are opened, and the air enters and drives the grout into the cavity. A man stationed at the 1-in. stopcock keeps opening it a crack; when air shows instead of grout, he closes the 2-in. stopcock, and the machine is recharged. If the cavity is open, the charge is pushed in in three or four seconds. By working continuously, more than 1,000 batches can be placed in 24 hours.

The grouting of the fissures was successful, and sinking was resumed. About 50 ft. farther down, another water-bearing fissure was drilled into; and this, instead of being open, was filled with sand formed by the crushing of metamorphic gneiss due to folding; this sand was carried up out of the drilled holes in large quantities by the water. Grout will not permeate sand, and it was necessary to continue drilling holes and pumping in grout, increasing the pressure at the end from 100 to 400 and 500 lbs. to the square inch. The sand was tamped so full of cement that, when cut through, it was compacted like sandstone and contained balls of grout from the size of a fist to as large as a man's head.

The most difficult grouting on the aqueduct was done on the Hudson siphon, which is a deep siphon tunnel under the Hudson River, at a depth of 1,100 ft. below tidewater. The shafts were sunk by the city forces, after which the contracts for the driving and lining of the tunnel and lining of the shafts was let. About 150 ft. from the foot of the east shaft, the heading cut a water-bearing fissure which flowed about 300 gallons per minute. The full flow did not develop until the cut was blasted. The problem then was to grout this flow against a hydrostatic pressure of 500 lbs. per square inch, with no solid rock to which to make grout pipe connections. This problem was finally solved by the construction of a concrete bulkhead 8 ft. thick across the full section of the head. The concrete was mixed in proportions of 1:2:4, and was heavily reinforced with rails set into holes drilled laterally into the sides, roof, and floor of the tunnel. Grout pipes leading into the fissure were set through the bulkhead. After the concrete had set for a week, grout was forced into the fissure, first by the pneumatic process with a high-pressure air-compressor, and finally by means of a high-pressure plunger pump which forced water instead of air into the grout tank. Pressures were reached in this way up to 1,000 lbs. per square inch.

In driving or sinking through rock containing a large number of seams carrying small quantities of water, it is not practicable to stop and grout each seam as described above. In this case it is advisable to increase the section of tunnel or shaft sufficiently to allow for a heavy concrete lining. Drains should be provided opposite all the water-bearing fissures, to carry off the water while the lining is being placed. After the concrete has secured sufficient strength, the drains may be grouted. By a combination of these two methods, it should be possible to penetrate any firm rock, no matter how much water it contains.

The best system of estimating is liable to get out of joint unless given individual attention. Some contractors adopt a rigid system and stick to it. They are so sure of it that they will turn the formula over to a clerk or typewriter, and leave the job to him or her. The results once in four or five times are bound to be disastrous. Every system must be more or less flexible, and above all it needs the individual oversight of the man most vitally concerned.

IF

(By Robert Isham Randolph, in Engineering and Contracting. With apologies to Rudyard Kipling.)

If you can swing an axe, or wield a brush-hook,
Or drive a stake, or drag a chain all day
If you can scribble "figgers" in a note book,
Or shoot a range pole half a mile away.
If you can sight a transit or a level,
Or move a target up and down a rod.
If you fear neither man, nor devel,
And know yourself and trust the living God.

If you can wade a swamp, or swim a river,
Nor fear the deeps, nor yet the dizzy heights.
If you can stand the cold without a shiver,
And take the Higgin's ink to bed o' nghts.
If you can turn a thumb screw with your fingers,
When every digit's like a frozen thumb.
If you can work as long as daylight lingers,
And not complain, nor think you're going some.

If you can sight through tropic heat's refraction,
Or toil all day beneath a blistering sun.
If you can find a sort of satisfaction
In knowing that you've got a job well done.
If you can be an esquimo and nigger,
And try to be a gentleman, to boot.
If you can use a "guessin' stick" to figger
And know a coefficient from a root.

If your calculus and descriptive are forgotten,
And your algebra just serves you fairly well.
If your drafting and your lettering are rotten,
And your Trautwine's always handy by to tell.
If you can close a traverse without fudgin',
Or check a line of levels by a foot.
If you can set a slope stake, just by judgin',
And never kicked a tripod with your foot.

If you can run a line where you are told,
And make it stay somewhere upon the map.
If you can read your notes when they get cold,
And know that contours mustn't ever lap.
If you can line a truss or tap a rivet,
Or make a surly foreman come across.
If you can take an order, well as give it,
And not have secret pity for the boss.

If you can climb a stool and not feel lowly,
Nor have your head turned by a swivel chair.
If you can reach your judgments slowly
And make your rulings always just and fair.
If you can give yourself and all that's in you
And make the others give their own best, too.
If you can handle men of brawn and sinew,
And like the men and make 'em like you too.

If you can't boast a college education,
Or, if you've got a sheep-skin, can forget
If you get a living wage for compensation,
And give a little more than what you get.
If you can meet with triumph and disaster
And treat them without favor, nor with fear,
You'll be a man—and your own master.
But—what is more—you'll be an ENGINEER.

The Imposing New Building Erected at Toronto for Knox College

THE plan adopted for the new Knox College divides the organization into two distinct groups—one comprising the Academic rooms, Library and Chapel, and the other the Dormitories, Living Rooms and Dining Hall. The Academic portion of the building is 285 feet long from north to south, nearly filling the west side of the University lawn, which at present is bounded on the north by the old University College, on the east by the University library and on the south by the open approach and the Convocation Hall. The residential portion of the building extends along St. George Street a distance of 224 feet. The space between these two buildings forms a quadrangle about 100 feet wide by about 200 feet long, bounded on the south by the extension of the Dormitories, and to be bounded on the north by future extensions, for which space is left on the lot, which is altogether 333 feet long by 234 feet wide.

There is a Cloister traversing the quadrangle, so as to obtain protected communication from the Academic portion of the residence portion of the building. This cloister is only one storey in height, so as not to interfere with the wide, open and attractive impression of the quadrangle, which can be appreciated through the traceried windows on both sides of the cloister. The building facing the University lawn is practically divided into two. On the south is the Chapel and on the north is the Library, with the lecture rooms below. The central part, being the entrance hall, is only one storey high, thus enabling one to see over this part and obtain a glimpse of the buildings on the far side of the quadrangle. This produces that effect of a group of connected buildings surrounding a quadrangle, each serving a different function in the community life of the college—an arrangement which has been proved of such great beauty and charm in the English colleges at Cambridge and Oxford.

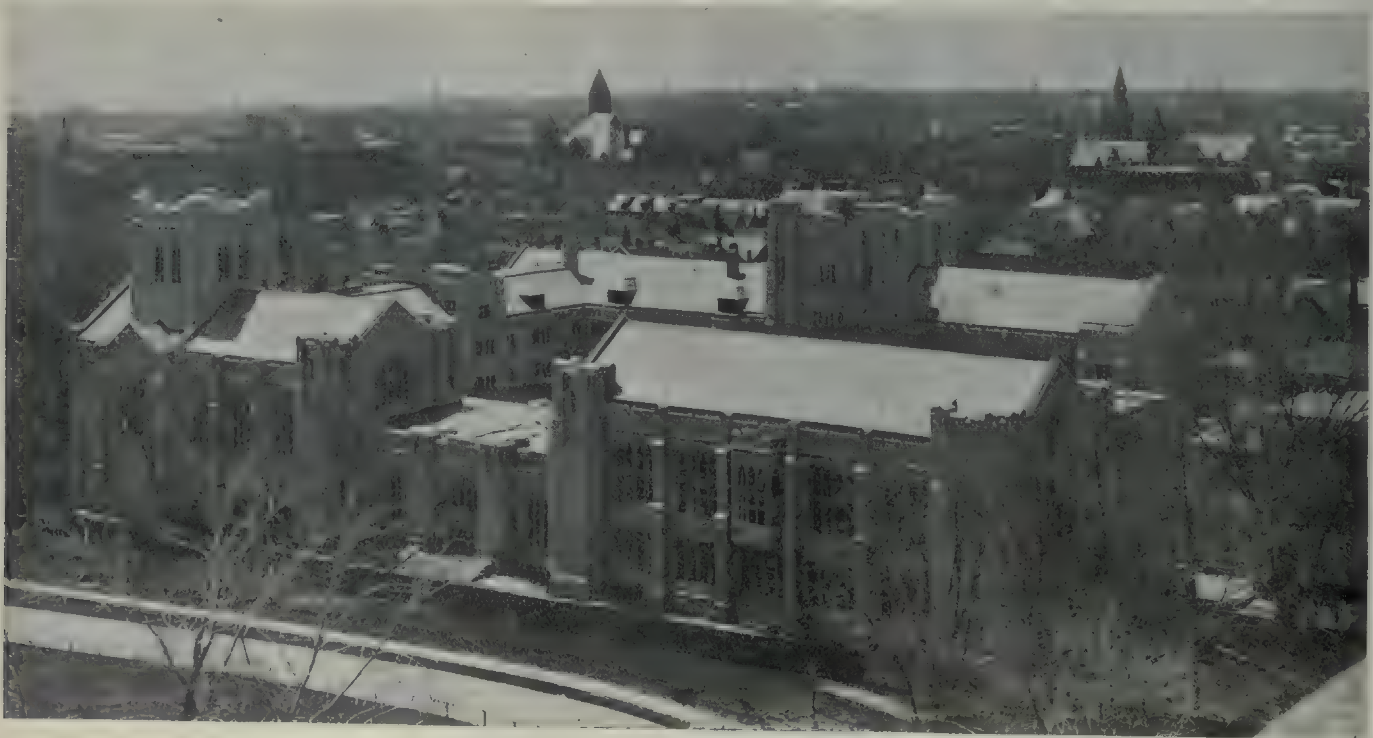
The collegiate style of Gothic architecture has been chosen because it lends itself to more modern academic lighting requirements. This style has been given a heavy massive character to harmonize more with the University College Building and also to give a suggestiveness of the traditional massive Scottish architecture.

The two monumental elements of the plan—the chapel and the library—have been kept on the same axis, so that from the large vaulted entrance hall one has a view on the left up a short, but broad, flight of stairs, through the glazed tracery of the entrance into the chapel beyond, and on the right one has the same monumental approach with a suggestive view of the library beyond. A view of the cloister leading to the residential sections is also obtained from the entrance hall.

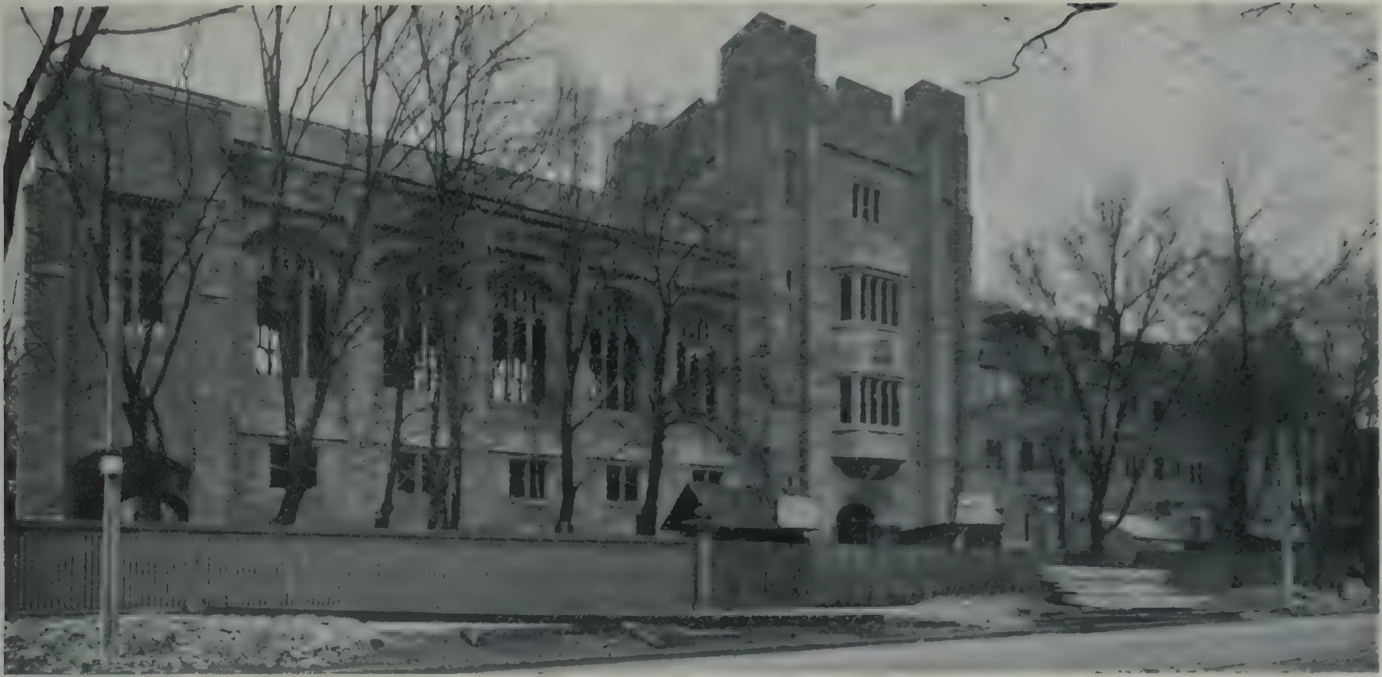
To add to the home-like and self-contained character of the college, it has been deemed advisable to enter the residences from the large open quadrangle rather than from the street. There are three separate houses containing the bedrooms, together with ample accommodation in the way of sitting rooms, bath rooms, etc.

The entrance to the Dining Hall is up a broad flight of stairs in a vaulted entrance hall. The Reading Room and an extra room for special re-unions are above this, and in the upper part of the tower, entirely cut off from the rest of the building, is the Hospital.

The general building material throughout the exterior is Credit Valley stone, trimmed with Indiana limestone, the roof being covered with unfading green



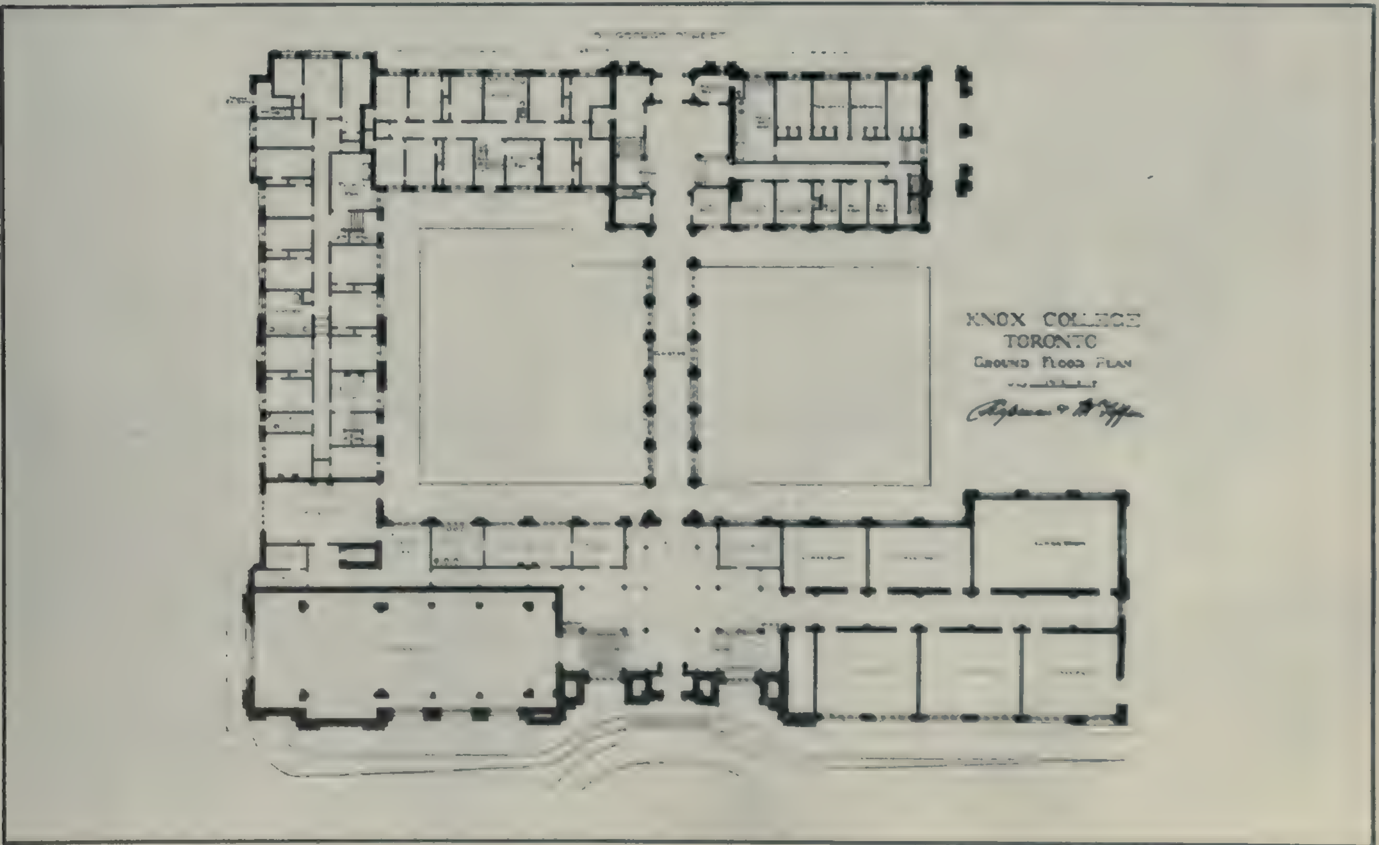
Knox College, Toronto.—View from tower of Main University Building, showing Academic portion in foreground.



Knox College, Toronto.—St. George Street Elevation, showing Dining Room and Residence portion.

slate. Metal casements with leaded glass have been used throughout. The construction of the building is of steel frame, reinforced concrete slab and tile partitions. The building is thus fireproof, with the exception of the open timber roof construction over the Chapel, Dining Hall and Library. Terrazzo floors are used in the entrances and corridors, quarry tile in the Dining Hall and Chapel, and Tennessee marble for the treads and risers of stairs in the main entrance. The interior walls of the Chapel and entrance halls are built up with Art stone cast on the premises. This has also been used for trimming the large windows in the Library and Dining Hall. Mechanical ventilation is used in connection with the heating plant, which is connected with the central University heating plant.

The contractors employed on the work were as follows: masonry—H. N. Dancy & Son, Limited; cut stone—Geo. Oakley & Son; structural steel—Canada Foundry Company; carpentry—Thos. Painter & Son; roofing—G. Duthie & Son; lathing, plastering and cement block work—Hoidge & Sons; painting—J. McCausland & Son, Limited; glass—N. T. Lyon Glass Company, Limited; plumbing, heating and ventilation —John Ritchie Plumbing & Heating Company, Lim-



ited; electrical—Keiths, Limited; vacuum cleaning apparatus—Zimmer Vacuum Machine Company; steel sash and metal casement frames—Henry Hope & Son, Limited; book stacks—Snead & Company Iron Works; bookcase shelving, magazine racks, etc.—Lindsay Library & Office Fittings, Limited; elevators—Otis-Fensom Elevator Company; pink Tennessee marble base, treads, risers, strings—Marbles & Tiles, Limited; steel work for stairs—Toronto Structural Steel Company, Limited; Balustrades—McGregor & McIntyre; terrazzo, cement and quarry tile—Italian Mosaic & Marble Company; concrete walks—A. Gardner & Company; five pairs Crittall solid steel doors—Crittall Casement Company; harware—Canada Hardware, Limited; guards for windows—Geo. B. Meadoks; electric fixtures—McDonald & Willson.

End Supports of Lachine Bridge Spans

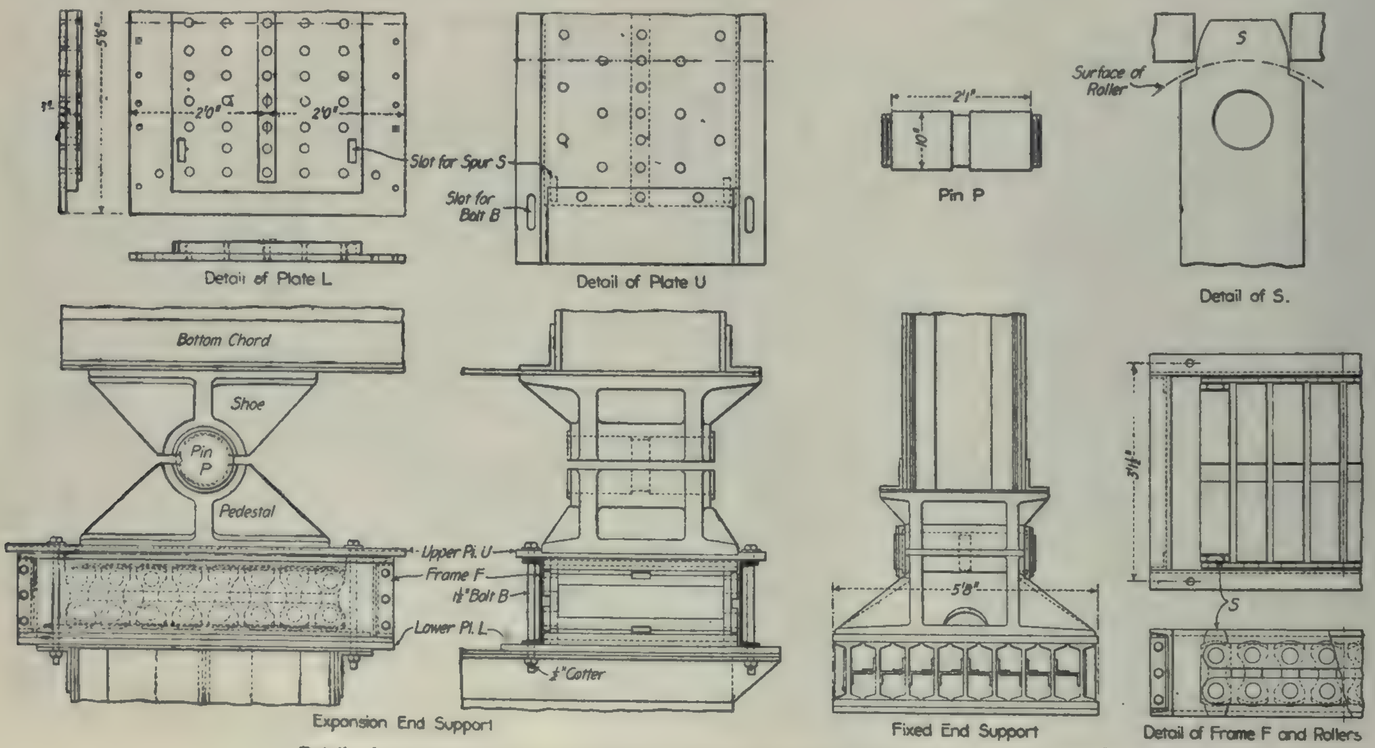
Pedestals are Supported at Expansion Ends on Nests of Segmental Rollers with Special Interlocking and Protection

THE four 1300-ton single-track 408-ft. spans of the Canadian Pacific Railway Bridge across the St. Lawrence River, at Lachine, Quebec (the reconstruction of which has been featured in previous issues of the Contract Record), have rivetted trusses with the reinforced ends of the lower chords seated on cast-steel shoes pin-connected to pedestals which, at the expansion end, are supported on nests of segmental rollers with special interlocking and protection.

Both shoe and pedestal have full-length half-hole bearings on 10-in. steel pins 25 in. long, grooved in the centre to interlock with ribs in the bearings. The pedestal takes bearing between planed guide ribs on a rivetted bedplate reinforced on the under side to engage the rollers. The rollers are inclosed in a tight channel-iron frame that thoroughly protects them from dust or disturbance, and they rest on a heavy reinforced bedplate which, like the upper bearing plate, has a longitudinal centre guide rib engaging a notch in the rollers, and is accurately machined on all of the bearing surfaces. The upper and lower plates of the frame are bolted together and connected to the structural steel supports by vertical bolts passing through slotted holes in the upper plate to permit movement relative to the other members.

The rollers are of the usual segmental type except that the two end rollers have projecting from both ends trunnions which engage vertical bars having top and bottom cycloidal teeth registering with slots in the bedplates, thus controlling the movement of the segmental rollers and affording a simple method of maintaining them always in their correct relative positions. At the fixed end of the bridge the roller bearings are omitted and the lower pedestal is seated on a grillage of I-beams connected by top and bottom countersunk rivetted bedplates and by a diaphragm of horizontal, longitudinal angles rivetted to their webs and rivetted together through their overlapping flanges.

This plan of support was designed by Mr. P. B. Motley, Bridge Engineer, and has been adopted for many important structures. For the Lachine Bridge it was fabricated by the Dominion Bridge Company.



Details of expansion and fixed end supports of spans in St. Lawrence River Bridge at Lachine.

Short Cuts for the Road Contractor

By C. D. Franks

It frequently becomes necessary to take a section of pipe from the pipe line to remove an obstruction or for some other purpose. For this reason unions which will allow one pipe to turn without turning the one next to it should be placed at distances not to exceed 500 ft. apart. Otherwise, the entire pipe line must be turned to remove one section, necessitating the use of unreasonable force. Tees and taps should be placed in the line not farther apart than twice the length of hose which will be used to connect the water pipe with the mixer. This hose should be at least 1-in. in size to reduce friction and preferably should be short for the same reason, so that it will be well to space the tees and taps not farther than 200 ft. apart.

Some sort of relief valve must be used in the pipe line so as to prevent the breaking of the pipe or the blowing out of the cylinder head in the pump when it is running and no water is being used. Spring relief valves have been used with success, but a simple arrangement may be used to take their place. At one of the tees previously placed in the pipe line near the mixer, insert one or more lengths of pipe vertically upward. The top end of this pipe is to be left open. This standpipe should be moved frequently so as always to be close to the mixer.

Expansion joints of some kind must be placed in the pipe, preferably at distances not to exceed 2,000 ft. The copper expansion joint is a standard fitting and is often used for this purpose, or a satisfactory expansion joint may be formed by three sets of fittings consisting of two elbows and a nipple, so placed as to make a "V" in the pipe line. Another satisfactory method is to offset the end of one pipe from the other slightly—say a distance of 3 ins. These two ends should then be connected with a rubber hose. Connections of this hose with the pipe must be tightly made in order to prevent leaks and the hose should be of a size at least equal to that of the pipe to reduce friction, which naturally will be greater where the water is forced through any bend. Sufficient hose should be used to provide for a movement in the pipe of 6 ins.

Boiler Plate Runways

It is customary, to prevent cutting up the subgrade, to lay planks up it for wheelbarrow runways. These planks are heavy, they become watersoaked, and their thickness makes wheeling on to them a difficult matter. One contractor was able to procure a large amount of scrap boiler plate which was ¼ to ⅜-in. in thickness. This made excellent runways for the wheelbarrow, reduced the labor of wheeling, and the contractor who used this scheme thought that it saved him considerable money.

Of all the tools used on concrete roads, probably none should be of more interest than the split float, because of the fact that in some cases roads and pavements are built without protection at expansion joints. When expansion joints are built without protection plates, it is always advisable to allow the expansion material, usually tarred felt, to extend a short distance above the finished surface of the pavement so that later it will iron out over the joint and protect the edges of the concrete. It is difficult for the average workman to finish the concrete on both sides of the tarred felt at the same level where this felt extends from ¼ to 2 ins. above the finished surface of the pavement. To obviate this difficulty the split float was designed. It consists of two small wooden floats spread about ½ in. and connected by a handle.

Expansion Joints

When protection plates at transverse expansion joints are used the plates do not always arive on the job in satisfactory condition, for the rough handling they receive in shipping will sometimes bend them out of shape. To bend out the shear anchors of steel plates, use a 36-in. length of 1½-in. pipe. It is a good idea to give the prongs a half turn after they are bent up—a monkey wrench is a convenient tool to use for this purpose. For wide pavements the installing device will sag a certain amount so that in making up a joint, three "horses" may be necessary and when the workmen set the tee-installing bar on them, they should stretch a chalk line over the ends and raise or lower the centre horse until the crown at the centre of the bar is correct. The workmen can then proceed to fit the steel plates to the tee-bar and know that when they fit they are correct for the crown.

Plates as they come from the factory are not always uniformly curved and must be "pened" out with a hammer. A 3-lb. ball pene or machine hammer is most satisfactory and a small anvil or length of railway rail is convenient. Very often when the plates are placed on the tee-bar they touch it in several spots only throughout its length. Hammering down the edge of the plate will have no effect whatever on the Baker type, but if the plate is laid flat on an anvil and the ball end of the hammer is used to strike at the points where the plate does not touch the bar, the plate will be expanded at those places and so will conform to the proper curve with one or two trials. It is important to have this done, as otherwise the steel will catch on the strike-board in places and leave hollows in others, will look very bad and will not provide adequate protection.

In placing a joint on a wide street with a tee-bar installation where will be some sag at the centre. This may be prevented by the use of a pin having a lug upon one side. The pin is driven and the lug is set by measuring from a line stretched from one side of the pavement to the other over the forms or curbs so that it will be at the exact elevation desired for the surface of the finished pavement. The tee-bar, when set in place, rests upon the lug. It may be necessary to use three of these pins, one at the centre of the street and one at each of the quarter points. Wooden stakes are often forgotten and left in the pavement. The iron stake can be given a quarter turn to release the shoulder and will never be forgotten because it projects above the concrete.

The contractor to-day finds his business raised to a higher standard than ever before, and old, obsolete methods do not prevail. Other contractors are studying efficiency, and they are getting better work out of their men. As a result of this a shrewd business man can make a low bid and still realize a fair profit, while another man might lose on it at that price. The loss of time through fussing at the beginning and preparing the scaffolds and preliminary stages of a contract must be eliminated so far as possible. The contractor must consider in his work of estimating, then, his own efficiency and that of his plant and workmen.

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[*] Paper presented before the Indiana Engineering Society.

The First Essentials in the Preparation of Reliable Estimates

ESTIMATING on contracts frequently makes or breaks a man, writes Edwin L. Seabrooke, in The National Builder. It is so easy to underestimate on a job in order to secure it against all competitors, that many builders and contractors today much prefer the cost plus commission method of building as a certain way out of the dilemma. It is certainly more just to both builder and client, for neither can then lose, and no exorbitant profit can be made by the contractor if his bid should happen to be larger than the conditions demanded.

But the old method of competitive bidding still prevails in most parts of the country, and it will continue perhaps for many years to come. The architect has a much easier time of it than the builder in making estimates. He arbitrarily makes his estimate on the cubical contents, assuming for convenience a standard cost per cubic foot.

This method is too careless and slip-shod for the contractor. The architect is often thousands of dollars out of the way. If he assumes that a good wooden building in a certain locality can be built for 15 cents per cubic foot, and bases his estimate on this unit measurement, he will present his figures to his client as a guide. Now the client, when bids begin to come in from the contractors, is disappointed to find that the architect's estimate is altogether too small.

The cubical content method of estimating is merely a snap-shot guess, and nothing else. There is a great variety of prices found among architects as to the cost per cubic foot of a house. One will assume that a certain structure can be built for 18 cents per cubic foot; another says it can't be done for less than 20 cents, and a third may estimate on 21 cents. The shrewd builder accepts the figure of neither, but begins his figuring from the foundation up and arrives at his estimate by a process all his own.

One of the weaknesses of the method of figuring on the cubical contents as a guide is that it does not adjust itself sufficiently to the fluctuation in prices for materials and labor. There are houses built a few years ago at a cost of 18 cents per cubic foot that could not be duplicated to-day for less than 20 cents. It would be fatal for a contractor to take one of these houses as a guide.

The first essential in making reliable estimates is to keep cost sheets of materials and labor on file and constantly change and bring them up to date. The most successful contractors have such cost sheets indexed and filed away for ready reference. By a little comparison with the market prices of materials at any given time they can be used as a certain guide. If the net cost of brickwork is figured at $14 per thousand with bricks at $8 per thousand and labor at $6 a day for good masons, the contractor would be all wrong in his estimates if bricks advanced or declined a dollar a thousand or if wages fluctuated up or down.

He must know first of all the cost of his material and labor at the time the job is to be done. It is even possible that a sharp variation may take place in the market between the time of bidding and actually beginning work. This is something that the shrewd contractor can often foresee if he is in close touch with the market. Before revising the cost sheets of labor and materials to fit any particular job it is wise to look even a few months ahead. Frequently on a rising market contractors can place tentative orders for materials on the strength of getting a contract a few months ahead, and arrangements can be made to cancel the orders if the job falls through. One cannot be too particular in this way to protect his interests.

With cost of labor and materials well in hand, the work of figuring out the total estimates of a job may then go forward. No two contractors follow the same line of figuring. One man figures upon the net cost of a job and then adds a percentage for profit. Another makes estimates of net cost and adds a percentage profit to each item as he goes along. For instance, if he figures on brickwork at $12 per thousand net, he adds $4 for profit and puts it in at $16 per thousand.

The contractor has far more elements of chance to contend with than the architect. The latter's figures are purely arbitrary and theoretical. The contractors' must be of a practical nature, making full allowance for strikes, delays by weather, and interruptions through delivery and differences with the architect and owner. There are a dozen and one contingencies that he must face, and if due allowances are not made for these he may lose on the job.

Another thing that a builder or contractor must take into consideration in making estimates is the character of his plant equipment. The cost of a big job can be reduced materially if one has a full equipment of labor-saving tools and implements, such as automatic hod carriers, derricks for handling heavy pieces, concrete mixers, wheelbarrows that can be lifted easily by carriers from the ground floor to the top, and many other little things that count for efficiency. One whose work has always been confined to small jobs would not have such equipment, and he would have to subtract from the saving obtained by their use the cost of buying them new. The big contractor, on the other hand, would have all the necessary tools and appliances, and he would have an advantage over the small man.

The foreman and workmen under him are also factors in the situation that count greatly. A trusted foreman who can be depended upon to get a certain amount of work out of his men on time is often of more value to a contractor than anything else. A new foreman might bungle the job and reduce the efficiency ten or twenty per cent. Poor mechanics may upset a man's estimates so that a profit can be turned into a loss.

As an illustration of the value of good tools, as well as good mechanicians, a contractor had to tear up the concrete base of a floor in which mosaic tiles were laid as a result of a mechanic's inaccurate level. Neither he nor the mechanic took the trouble to check off his level to see if it was plumb. The floor was laid and the tiles set before the contractor's eyes made him question it. The mechanic proved by his level that it was correct. Still doubting it a new level was purchased and laid on the floor. The bubble would not come into the middle. The old level was out of plumb, and hence the floor was. There was no way other than to tear up the floor and do it over again, which cost the contractor a good sum.

In bidding against competitors a contractor who finds his bid a good deal lower than any of the others is startled before he is jubilant. Of course, he wants the job; that's why he bid for it, but to find his figures away below the others makes him feel that there is something wrong. His first thought is that he has made an under-estimate through a mistake, and he is worried until the figures have been carefully checked up. It is a simple matter to make mistakes with figures, so simple that the most successful contractors never trust themselves alone in making an estimate. They have somebody else to check them off, but this is often done perfunctorily. Another person going over his figures may pass over the same mistake without discovering it.

The most satisfactory method is that found in practice in one of the biggest contractor's office in the country. Two independent estimators are set to work. They first revise their cost sheets of material and labor and then proceed without consulting each other in making up the estimates. If they both agree or come within a few hundred dollars of each other, it is pretty good evidence that they have not made errors.

Chart for Computing Capacities of Belt Conveyors and Required Horsepowers

With these charts it will be found easy to compute the capacities of belt conveyors and horsepowers for driving them. The first chart shows capacities in tons of material per hour for belts of various widths.

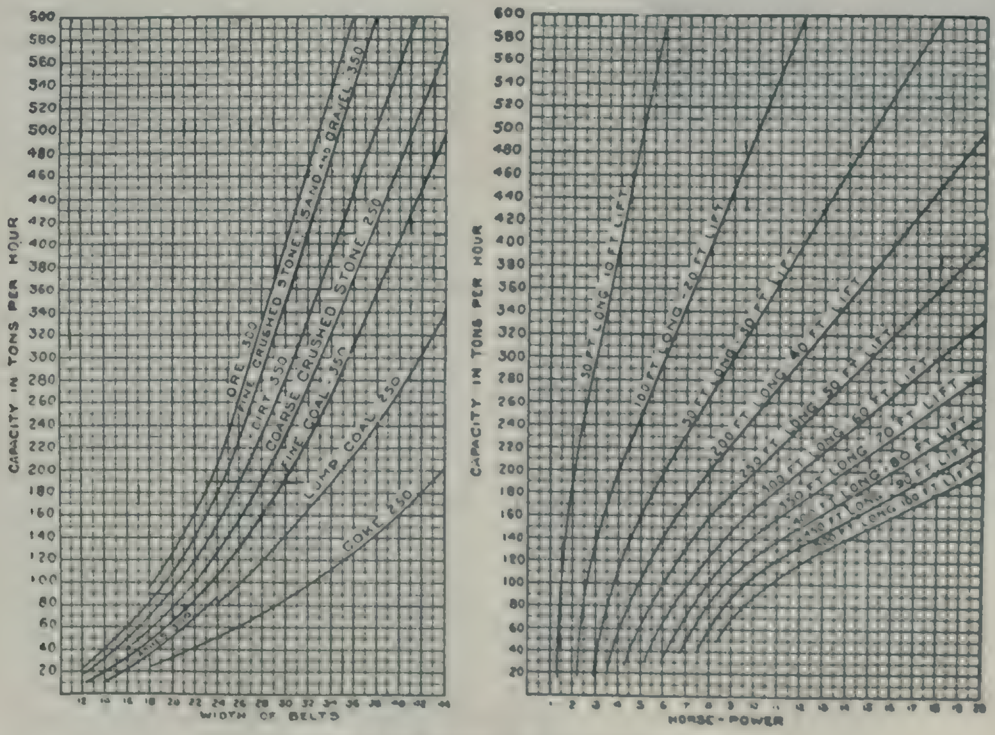
On the curves for the different kinds of material are given the speeds at which it is recommended that the belts be run for carrying the several materials. For carrying crushed stone (or crushed fire-clay or shale) for instance, the recommended speed would be 250 feet per minute, for all belt widths.

In reading these charts, read "crushed stone, shale or fire-clay" where the chart reads "crushed stone."

To find the size of belt necessary to handle any given amount of material, find the quantity in tons per hour at the left side margin of the chart, and follow it horizontally until the curve for the given material is reached; thence directly downward to the bottom of the chart to determine width of belt. Thus—to convey 240 lbs. of crushed stone, fire-clay or shale per hour we find that a 30-in. belt is necessary.

To compute the horsepower to handle this same amount, on a conveyor 250 ft. long, begin at the left margin of the right-hand chart, as before, at 240 tons capacity per hour, and follow horizontally until the curve for 250 ft. length is reached, then follow downward, and, at the bottom of this chart, we find 12 h.p. This is for a horizontal conveyor.

Now, if the conveyor is inclined, so as to raise the material, we must increase the power accordingly. The curves in the charts are numbered for lift distances as well as for conveyor lengths. To obtain the horsepower required for the lifting of the materials as above (240 tons per hour), through a height of, say 40 ft., follow as before along the horizontal line 240, until the cruve representing the 40 ft. lift is reached; then downward to the bottom scale to find 9½ h.p. as the horsepower required. Thus—12 plus 9½ equals 21½ h.p. It takes practically the same power to convey 250 ft. as it does to raise 50 ft. and for this reason one curve is made to serve for both computations.—Brick and Clay Record.



Capacities of belt conveyors and required horsepowers

Vancouver Builders' Exchange

AT the Annual Meeting of the Vancouver Builders' Exchange Mr. J. L. Skene was elected President, Mr. J. G. Anderson First Vice-President, and Mr. A. G. Brown Second Vice-President. The Directors are Messrs. W. O. Marble, W. M. Horie, J. O. Perfect, T. Borgford, D. H. Wilkie, C. T. McPhalen, J. Tucker, T. G. Bird, W. C. Creer, R. H. Gale, A. P. Bogardus, H. C. Douglas, J. Bain, and F. A. Worth. The Secretary is Mr. W. Hamilton-Lindsay, and the Treasurer Mr. W. N. O'Neil. In the course of his address, the President alluded to the fact that in spite of the strenuous times the membership had increased on a gratifying scale. Little building was in progress, but during 1915 he hoped to see operations commenced on the Great Northern Station, the Second Narrow Bridge, and a number of new schools and banks. In regard to the policy of the Exchange, Mr. Skene said that the wage scale that had been put forward was the outcome of careful thought and an earnest desire to adjust the matter fairly for both employer and man. The Vancouver Builders' Exchange stood for efficient work fairly renumerated according to individual ability.

The following has been adopted by the Purchasing Department of the B. J. Coghlin Company, Limited, Montreal:—

"We will buy Canadian-made goods as far as possible, submitting samples of our requirements and giving Canadian manufacturers every assistance to supply our wants, and where we cannot buy in Canada, we will give every preference to the Mother Country and other parts of the Empire."

Bacteriological Standard for Drinking Water

THE following bacteriological standard for drinking water has been adopted by the U. S. Treasury Department. A chemical standard is under consideration by the experts of the Department, and will be submitted for adoption later on.

The following are the maximum limits of permissible bacteriological impurity:

1. The total number of bacteria developing on standard agar plates, incubated 24 hours at 37 deg. C., shall not exceed 100 per c.c. Provided, that the estimate shall be made from not less than two plates, showing such numbers and distribution of colonies as to indicate that the estimate is reliable and accurate.

2. Not more than one out of five 10 c.c. portions of any sample examined shall show the presence of organisms of the bacillus coli group when tested as follows:

(a) Five 10 c.c. portions of each sample tested shall be planted, each in a fermentation tube containing not less than 30 c.c. of lactose peptone broth. These shall be incubated 48 hours at 37 deg. C. and observed to note gas formation.

(b) From each tube showing gas, more than 5 per cent. of the closed arm of fermentation tube, plates shall be made after 48 hours' incubation, upon lactose litmus agar or Endo's medium.

(c) When plate colonies resembling B. coli develop upon either of these plate media within 24 hours, a well-isolated characteristic colony shall be fished and transplanted into a lactose-broth fermentation tube, which shall be incubated at 37 deg. C. for 38 hours.

For the purpose of enforcing any regulations which may be based upon these recommendations the following may be considered sufficient evidence of the presence of organisms of the bacillus coli group.

Formation of gas in fermentation tube containing original sample of water (a).

Development of acid-forming colonies on lactose litmus agar plates or bright red colonies on Endo's medium plates, when plates are prepared as directed above under (b).

The formation of gas, occupying 10 per cent. or more of closed arm of fermentation tube, in lactose peptone broth fermentation tube inoculated with colony fished from 24-hour lactose litmus agar or Tndo's medium plate.

These steps are selected with reference to demonstrating the presence in the samples examined of aerobic lactose-fermenting organisms.

3. It is recommended, as a routine procedure, that, in addition to five 10 c.c. portions, one 1 c.c. portion and one 0.1 c.c. portion of each sample examined be planted in a lactose peptone broth fermentation tube, in order to demonstrate more fully the extent of pollution in grossly polluted samples.

4. It is recommended that in the above-designated tests the culture media and methods used shall be in accordance with the specifications of the committee on standard methods of water analysis of the American Public Health Association.

In submitting the recommendations above quoted the commission emphasized the fact that the limits defined are recommended with reference solely to the special object of the control of the supplies of common carriers, having in mind that these supplies constitute a special case because of the following reasons:

1. The supplies come from widely diversified and mixed sources.

2. Samples taken from common carriers represent waters stored for various lengths of time under varying conditions.

Tidal Wave Overwhelms B.C. Quarry Plant

DETAILS of an unusual calamity which befell the men employed at the Pitt River quarry of the British Columbia Transport Company, reached New Westminster recently. The news was that following the explosion of a huge blast of 8,000 pounds of giant powder in the company's rock quarry, the whole face of the hillside slid into the river, the sudden displacement of water causing a tidal wave which swept away the entire plant, located on a bench some considerable distance above high water mark. Seventy men comprising the working force were on the premises at the time, many being asleep in the bunkhouses: of these three were killed and seven were injured, while many had miraculous escapes. The bodies of the missing men were not recovered and it is likely they are buried beneath tons of debris. The quarry was under lease to the contracting firm of Moore & Pethick, Victoria, who were taking out rock for the jetty work in progress at the mouth of the Fraser River. W. I. Moore, manager of the firm, was in charge of the camp.

The huge blast was fired in order to loosen large quantities of rock for the succeeding week's operations. Preparations for the blast, which ended so disastrously, had been in progress for several days. A "coyote" hole some three feet in diameter had been driven into the face of the rock for a distance of about fifty feet. Two cross sections had been excavated some sixty feet, and at the ends of the tunnels blasting powder to the amount of four tons had been packed. The night crew were laid off and the whole force instructed to get away out of danger when the blast was fired. A number of the men disregarded this warning and there were seven or eight in one of the bunkhouses, the remainder having sought shelter at the top of the cliff.

Louis Gasperin, an Italian, who operates a winch at the Gilley quarry immediately adjoining, succeeded in reaching the five injured men, who were clinging to floating logs and drifting away in the darkness. While the others were fleeing to safety he secured a boat, and engaged unaided in the work of rescue. His feat entitles him to a Carnegie medal and pension.

It is estimated the loss to the plant and buildings will be about $100,000. Included in the plant swept away was the heavy rock crusher, two air compressors, two belt conveyors, a small locomotive, sixteen rock cars and a donkey engine. A big dredge which was moored alongside the plant was turned completely over and badly smashed, and a floating scowhouse was sunk. The trestle work was swept away and the electric lighting plant was carried into the river. About 250 tons of coal was lost. Where the plant was sitting before the blast there is now about twenty-eight feet of water. Between five and ten acres of land was carried away in a few minutes. It is believed that the plant is a total loss, as it is unusual to carry insurance on outfits of this description except against fire, nor is it considered practicable to replace the plant, as the earth shelf which was used as its site has gone and there is now nothing but the sheer wall of rock. A big steam shovel still sits on its track at the quarry, but the slide is still proceeding slowly and it will shortly topple into the stream.

The accident is not attributed to the size of the blast, as last September the same firm safely fired a five-ton powder blast, and at Gilley Bros. quarry adjoining, a 3½-ton blast is common. The loose earth site of the plant is believed to be alone responsible for the disaster, as it could not resist the immense wave.

The Lottie N., a tug owned by the Marsh, Hutton, Powers Company, who have the contract for the jetty work in the North Arm of the Fraser, was lying near the plant at the time. She broke loose from her moorings and was slightly damaged. One of the buildings on the shore was swept right up on to the decks of the tug.

J. H. Chisholm, one of the engineers killed, was a shovel-runner. He leaves a wife but no family. His wife had been with him at the plant until a short time ago, when she came to New Westminster to live.

Notified by telephone, a party from New Westminster set out about midnight to go to the quarry, but so dense was the fog that it was after 9 a.m. on Sunday before they reached there. Dr. McQuarrie, of New Westminster, coroner for the district, and Dr. Sutherland, of Port Coquitlam, attended the injured men, who were taken to the Coquitlam hospital.

This disaster recalls to old-timers the landslide at Maple Ridge, some thirty years ago, when 30 acres slid into the Fraser River, practically blocking it. The great wave following caused some loss of life and considerable damage to property.

Public Work in the West

Government votes for public buildings in the west include the following:

Winnipeg: Barracks, $150,000; Dominion buildings, improvements, repairs, etc., $20,000; drill hall (new), $170,000; new immigration building, $40,000; north drill hall, $70,000; postal station "E," $25,000; postal station "C" (south), $73,000; postal station "D" (west), $75,000.

Saskatchewan: Battleford, public building improvements, $4,600; Canora, public building, $10,000; Indian Head, forestry branch, $17,000; Kindersley, public buildings, $20,000; Moose Jaw, customs examining warehouse, $90,000; immigration hall, $50,000; new public building, $15,000; Prince Albert, driil hall, $80,000; Regina, armory and drill hall, $75,000; accommodation for assistant governor-general, $75,000; customs examining warehouse, $75,000; Rosthern, public building, $10.000; Saskatoon, customs examining warehouse, $50,000; drill hall, $30,000; new public building, $75,000; Swift Current, drill hall, $30,000; public buildings, $50,000; Wadena, public buildings, $20,000.

Personal Mention

The City Engineer of Nelson, Mr. G. C. McKay, will resign his position.

Mr. James E. Beatty has been appointed Division Engineer of the Atlantic Division of the Canadian Pacific Railway, succeeding Mr. G. L. Wetmore, with headquarters at St. John, N.B.

Messrs. James Ewing, Edgar S. M. Lovelace and Altheod Tremblay, of Montreal, Que., have been registered to carry on business as civil engineers under the name of Ewing, Lovelace & Tremblay.

Mr. John Quinlan, Montreal

MR. John Quinlan, the new President of the Montreal Builders' Exchange is, like many Canadian and American contractors, of Irish descent, his grandfather having come to this country in 1798. Mr. Quinlan was born about thirty miles from Montreal. He is head of Messrs. John Quinlan & Company, general contractors, and is President of Messrs. Quinlan Cut Stone, Limited. He has been connected with the contracting business all his life. In 1907 he went to the North-West and founded the firm of Quinlan-Carter, Limited, for the purpose of supplying stone for several Government buildings in Western cities. After he had been President and Managing Director for some years, the business was sold to the Western Canada Stone Company, Glenbow, Alberta. During this period he was still carrying on his general contracting business in Montreal. In 1903 Mr. Quinlan had added to that business a cut stone branch, and twelve years later this was incorporated as Quinlan Cut Stone, Limited, a concern which has furnished stone to contractors all over the Dominion. Messrs. John Quinlan & Company have carried out a very large amount of work, particularly in Montreal. The buildings include the Power Building, Craig Street; Alexandra Hospital for Infectious Diseases; Royal Bank, Seigneurs Street and Notre Dame Street; St. Patrick's Orphan Asylum; Unitarian Church, corner of Simpson and Sherbrooke Streets; Baptist Chapel, corner of Sherbrooke Street and Union Avenue; St. Gabriel's Presbytery; a large portion of the gas works of the Montreal Light, Heat and

Mr. John Quinlan, the new President of the Montreal Builders' Exchange

Power Company, Hochelaga, and new works of the same company at Cote St. Paul. At present the firm are building the Congress Hall of the St. Patrick's Congregation, Westmount Post Office, and a number of private residences. The company make a specialty of deep foundation work, and have constructed the foundation for the Sun Life Building and the new Montreal High School. A considerable amount of tunnelling work has also been done for the Montreal Light, Heat & Power Company in connection with the new buildings at Cote St. Paul.

Mr. Wills Maclachlan, B.A.Sc., has been appointed to the position of Inspector of the Electrical Employers' Association of Canada. He was previously on the staff of the Electrical Power Company, Toronto.

Mr. Chester Hughes, B.A.Sc., has been given a commission in the 2nd Field Company of the Royal Canadian Engineers. He has been an assistant engineer on the St. John-Quebec Railway for a number of years.

Mr. B. Blonde, general contractor, of Chatham, Ont., has been appointed to superintend and erect the Ontario Hydro-Electric Commission's new plant at Chatham. Mr. Blonde will receive all tenders and quotations.

The appointment is announced of Mr. R. F. Armstrong, B.Sc., who has had considerable experience in constructional and municipal work in the West, as Superintendent of Water and Sewerage work at St. John, N.B. He is a graduate of the University of New Brunswick.

It is announced that Mr. G. L. Wetmore, C. P. R. Division Engineer, St. John, N.B., will retire on March 1st. Mr. Wetmore's experience in engineering work dates from 1872, when he was engaged on the survey of the North Shore of Lake Superior. He is the only member now on the engineer-staff of the C. P. R. who was engaged on the survey of the original road.

At the annual meeting of the Association of Manitoba Land Surveyors, held last month, the following officers were elected:—President, Mr. C. C. Chataway; Vice-President, Mr. W. B. Young; Secretary-Treasurer, Mr. W. E. Hobbs. Members of Council for two years: Messrs. R. H. Avent and J. Reid. Member of Council for one year, Mr. R. P. Wilson, Auditors, Messrs. S. E. McColl and G. A. Warrington.

Mr. Frank Darling, Toronto, designer of many of the Dominion's most stately public buildings, has been nominated by the Royal Institute of British Architects as candidate to receive the Royal Gold Medal. This honor carries with it the right of appending the letters "R. G. M." after the name of the recipient. Mr. Darling will probably be officially presented with the medal during the month of June.

The Montreal Building Trades Council have asked the Council to give every civic contract direct, instead of allowing work to be done through sub-contractors. It is claimed that friction arises between workmen and sub-contractors, owing to the latter sometimes objecting to pay the wage scale by which the contractor is bound. Controller Aney told a deputation that the workmen could claim from the original contractor the difference between the wages paid them and those in the fair wage scale.

Mr. Grant Hall, Vice-President of the Canadian Pacific Railway, states that although the programme of work in the West for 1915 as outlined by the company will not be as extensive as in preceding years, it is their intention to complete as far as possible the many projects already started, and also to spend a considerable sum on improvements, notably in the way of building new stock yards in small centres. There will be very little double tracking done outside of the Rogers Pass tunnel which is a part of the double-tracking scheme.

A Brief Description of Two Grain Elevators for Messrs. Arthur Guinness, Son & Co.

Messrs. Arthur Guinness Son & Company, Limited, the well-known stout brewers, of Dublin, are about to construct a large brewery at Manchester, England. The plans provide for an ultimate future capacity far in excess of anything in Great Britain at the present time. In connection with this brewery, two grain elevators will be required, and the contract for the designing of them has been secured by the John S. Metcalf Company, Limited, Montreal, London, Eng., and Chicago.

The wharf silo will be an elevator of 835,000 bushels' capacity, capable of extension to 3,750,000 bushels. Primarily it will be for the receipt and cleaning of barley and for the delivery of barley to the malt-house. Belt conveyors in a tunnel incorporated in the wharf wall will receive bulk or sacked barley from vessels at a rate of 6,000 bushels an hour primarily, and 12,000 bushels an hour in the future. Provision will also be made for the receipt of sacked barley from railway cars, for the shipment of sacked and bulk barley to vessels and of sacked barley by railway.

A complete cleaning plant is included, special attention being given to the treatment of Indian barley, which, under the present conditions of growth and handling in India, is exceedingly dirty. The wharf silo will deliver barley to the malt-house and will receive, from the latter, malt which will be cleaned in the wharf silo or will be forwarded to the malt store and brewery. A transit shed of 3,000 tons capacity, for the storage and handling of sacked grain, is included in the plans.

Malt House

The malt store will be an elevator of 600,000 bushels present capacity, designed for extension to 3,600,000 bushels. It will be capable of receiving malt from two vessels simultaneously and can also receive from the railway and from the malt house. It will clean malt at the rate of 5,400 bushels an hour at present and 14,400 bushels in the future. Cleaned malt will be held in the malt store, and delivered to the brewery as required.

Throughout both buildings particular attention will be paid to collection of dust. Both buildings will be entirely of reinforced concrete. The storage bins will be cylindrical in shape, with the interspace bins also used for storage. The bins in the wharf silo will be 16 ft. 2 in. in inside diameter and those in the malt store 14 ft. in inside diameter, the bin walls being about 85 ft. high.

The portions of the buildings holding the cleaning machinery will, in both cases, be of reinforced concrete column and girder construction, with concrete curtain walls. All machinery will be driven by electric motors in small units. The plants have had to be designed throughout so that operating and storage capacities can be easily extended as the growth of the business warrants. The estimated cost of the present elevator work is somewhat in excess of $600,000, which is a small portion of the appropriation for the primary construction of the new brewery.

In addition to these two elevators, the Manchester Ship Canal Company's elevator No. 2, for which the John S. Metcalf Company acted as designers and engineers, is about completed. This is an all-concrete elevator of 1,500,000 bushels capacity, costing about $900,000. It is designed to receive from six ocean vessels simultaneously and has enormous sacking facilities for the local British trade. Elevator No. 1, which the Metcalf Company buit a few years ago, of a similar capacity to No. 2, has been operating very successfully. With the completion of the Guinness elevators there will be four large houses on the canal to the credit of the Montreal, Chicago and London engineering firm.

MAINLY CONSTRUCTIONAL

EAST and WEST — FROM COAST to COAST

The London, Ont., City Council propose erecting a new fire hall.

Extensions to the waterworks system at Saskatoon are contemplated.

The post office at Preston, Ont., which has cost $50,000, is about completed.

The Cornish Park new library at Winnipeg, Man., is nearing completion.

The Kettle Valley railroad have been authorized to construct three bridges.

The sum of $25,000 will be raised by the town of Ladysmith, B.C., for street paving.

The Vancouver, B.C., Board of Health have recommend that sewers be laid on eleven streets.

A sum of $72,000 will be spent by the City of Ottawa for extensions to sewers and watermains.

The burning of the wharf and warehouse at Skagway, B.C., recently caused a loss of $210,000.

An hotel and business blocks valued at $130,000 have been destroyed by fire at Rock Island, Que.

The City of Winnipeg have under consideration the laying of sewers on several streets this spring.

The new City Hall at Weyburn, Sask., has been completed and handed over to the city by the contractors.

An expenditure of $40,000 will be incurred in improvements to the water and sewerage systems of Sackville, N.B.

The construction of a shingle mill having a capacity of 200,000 shingles per day has been commenced at New Westminster, B.C.

The Queen's Hotel, Barrie, Ont., which was destroyed by fire on February 10th, will be rebult at an estimated cost of $40,000.

A by-law has been passed by the citizens of Vernon, B.C., to expend $105,000 for the construction of sewers and a sewage disposal plant.

Excavation for the new subway at Moncton, N.B., was commenced by the contractors a few days ago. The work is being pushed along rapidly.

Building estimates aggregating $1,165,000 for high and public school buildings for Toronto have been approved by the Education Committee.

The St. John School Board contemplate the erection of a two-storey school building. Mr. F. Neil Brodie, of St. John, has been appointed architect.

The Ontario Legislature will be asked to approve a Bill giving power to adopt a general drainage system for the Counties of Leeds and Grenville.

The city council of New Westminster, B.C., have authorized that plans and estimates be prepared for a new market building at the foot of Tenth Street.

The Town Council of Paris, Ont., contemplate erecting two plants for the purification of water with ozone, each having a capacity of 9,900,000 gallons per day.

A new bridge, which will be one of the finest in the Maritime Provinces, will be built over the Petitcodiac River, between Moncton and Albert County, N.B. The first span from the Moncton side will be 359 feet long. It is expected that the Government will call for tenders in a short time.

A deputation to the Ontario Provincial Hydro-Electric Commission have requested a survey and estimates for a radial line in Whitechurch Township, York County.

Work in connection with the re-laying of the street-car track on Arlington Street, Winnipeg, Man., will be commenced as soon as the spring opens up.

The amount to be expended by the City of Ottawa for the completion of the aqueduct and intake pipe and construction of sedimentation basin will be $300,000.

A site 80 ft. by 350 ft. has been purchased at Windsor, Ont., by a Michigan firm for the erection of a Canadian Branch for the manufacture of scale attachments.

Damage by fire on Notre Dame Street, Montreal, was estimated at $200,000. The stores of A. Lavigne, Limited, Lamarre Freres and Wm. Lamarche were destroyed.

The Prince Rupert City Council will take the necessary steps to bring to the attention of the Government the desirability of making a start on defence works in this city.

Contracts have been closed for over 16,000,000 feet of Oregon fir to go to the United Kingdom, shipments to begin at once and continue at frequent intervals until completed.

Road and bridge work outlined by the Council of Middlesex County, Ont., are estimated to cost $96,000. The money will be raised and the work put in hand this season.

It is expected that the 20,000-ton dry-dock at Prince Rupert will be completed by June 1. Seven of the twelve pontoons have already been launched at the rate of one a month.

A new police building to cost about $750,000 designed to provide accommodation for the police force, court house, and a place of detention for remand cases, etc., is suggested for Toronto.

The Vancouver Terminal Railway Company is applying to the Federal Government for power to construct railroads in Vancouver, New Westminster, and at the mouth of the Fraser River.

The estimates of the Superintendent of Lighting for a street lighting system on St. Catherines and Bluery Streets to cost about $40,000 have been passed by the Montreal Board of Control.

The camp buildings for the Greater Winnipeg Water District will be erected soon. They will comprise section foreman's residence, wash, ice, bunk and dining houses, also telephone station.

Work on the Banff-Windermere Scenic Highway is to be commenced immediately, and rushed to completion. When finished, Calgary will be within a 9-hour automobile run of the Windermere country.

During the year 1914, fire loses throughout Canada amounted to $24,321,012. This represents an immense waste of valuable property, the deplorable feature being that it is due to rank carelessness.

In connection with the new water-works system for West Vancouver, B.C., a dam 125 feet long and 35 feet high will be built across Sister's Creek at an elevation of 750 feet above tide level. A reservoir capable of storing one million gallons of water will be thus created. To make the dam site easily accessible will require the clearing and grubbing of a new road 2,400 ft. long by 25 ft. wide. It is expected that the contractor will commence work immediately.

The Dominion Government Department of Public Works has under consideration the draining along six miles of the Lesser Slave River near Sawridge, Alta., so that many thousands of acres will be reclaimed.

A committee has been appointed by the Vancouver City Council to consider with the City Engineer the adoption of a suitable pavement for the Georgian Harris viaduct. Wood blocks and asphalt are proposed.

At Windsor, Ont., good progress is being made on the erection of a bank and offices, estimated to cost $150,000, for the Canadian Bank of Commerce. The building will be four storeys high, of brick fireproof construction.

The excavation for a $130,000 addition to the Ogilvie Flour Mills Company's elevator at Fort Wililam, Ont., is started. When the addition is completed the elevator will have an additional capacity of 750,000 bushels.

Plans are being prepared by the Vancouver, B.C., Water Department for the pulling of the third of the four 18-in. mains across the First Narrows. As it will be 2,000 feet in length, it will be pulled out in two or three sections.

For the immediate relief of the unemployed in Victoria, B.C., the city council have agreed to start work immediately on paving several streets and laying down sidewalks. Further work will also be planned to aid the unemployed.

The Kingston Board of Works have decided to lay a pavement of asphalt blocks on a concrete base as an experiment. Should it prove a success, the city council will decide whether more of this type of paving will be constructed.

City Engineer Fellowes, of Vancouver, B.C., recently reported to the city council that the plans for the Coal Harbor causeway were in shape for calling for tenders at any time. The matter will come up at the next meeting of the council.

The Quebec Government bill on the Good Roads Act, which has been printed, authorized the floating of a new $5,000,000 loan for the road improvements of the province. The sum of $10,000 was raised three years ago for the same purpose.

The Quebec Legislature has inserted a clause in the Montreal Council's Bill permitting the Electric Service Commission to allow poles to be erected in lanes running parallel to streets wherein conduits are laid. The object is to save expense.

It has been decided by the Montreal Controllers to buy stone in large quantities of 20,000 tons or more, the purchasing being by tender. Up to now, the practice has been to ask for the price per ton, without specifying the total quantity required.

Tenders are to be called in the near future for the section of the Bloor Street Viaduct from Parliament Street, to the Western Terminus. The estimated cost of this work is $300,000. It will consist mainly of a concrete retaining wall in the ravine.

Three storeys will be added to the Board of Trade Building, Toronto. This will rank it among the many high buildings of the city, and the whole building will be modernized. After the alterations the building will be known as the "Transportation Building."

At the recent meeting of the Ontario Land Surveyors' Association, it was suggested that a road from Windsor to Montreal be constructed as a means of commemorating the war, and also to help the unemployment situation. The proposed road would cost about $8,000 a mile.

The town councils of North Vancouver and West Vancouver, B.C., are urging the provincial government to compel the Pacific Great Eastern Railway to commence and effectively carry to a completion the Howe Sound branch of their line, from Horseshoe Bay to Squamish, immediately.

For 1914 the profits of the Standard Clay Products, Limited, St. Johns, P.Q., and New Glasgow, N.S., show an increase of $33,030, the total being $100,223. Deducting depreciation and bond interest, there is a balance of $47,306, as against $23,778. Adding the previous surplus the total is $89,718.

A trunk sewer to connect with the new sewage disposal plant will be constructed at London, Ont. Probably $50,000 will be spent on this work. Plans are also being prepared for the installation of pumps and hydraulic equipment at the Springbank Pumping Station. The cost of this scheme will be $30,000.

The Calgary Bricklayers' Union is considering the proposition of building the new relief sewer, over which there has been controversy between them and the City Commissioners regarding the wage scale. If the Union agrees to accept the job, it will be a profit-sharing undertaking rather unique in labor records.

The City Improvement League of Montreal has passed a resolution in favor of the establishment of a central free labor bureau for the Dominion and local bureau, under the control of an independent commission. A committee has also been appointed to look into the question of starting civic work in order to provide employment.

Grading is now approaching the completion stage on the entire line of the Pacific Great Eastern Railway. The contractors expect to have the intervening incompleted stretches on the roadbed prepared for the rails at the end of the month. The railway is ready for operation to Lillooet, a distance of one hundred and twenty miles north of Vancouver.

The Snoqualmie Tunnel, bored through solid rock 11,200 feet at the summit of the Cascade mountains in Snoqualmie Pass by the Chicago, Milwaukee and St. Paul Railway, has been opened. The tunnel cost $2,250,000, and its construction occupied more than two years. The new tunnel route saves four miles in distance and several hundred feet in grade.

Orders have been placed by the Canadian Pacific Railway, acting as agents for the British Government, for 4,200,000 feet of British Columbia fir to be used for railway sleepers. Contracts for the delivery of the ties have been distributed between eight local firms and one Vancouver Island concern. The orders will aggregate considerably over $400,000 in value it is said.

Owing to the fact that the typhoid epidemic at Brockville, Ont., is not abating, the Board of Health have instructed the Town Engineer to procure a plant for disinfecting the western sewage now flowing into the river. The advisability of having the diver now engaged in connection with the intake pipe make an examination of the sewer outlet was also considered.

The Canadian Northern Railway is now completed from Lake Superior to the Pacific Coast. The last rail was laid recently at Basque, a village on the North Thompson River, 200 miles east of Vancouver. It will require until April 15 to ballast the line, and the official ceremony of driving the golden spike probably will take place about May 1. It may be midsummer before a regular through service is begun.

The town of St. Lambert, P.Q., has issued the annual report for last year, compiled by Mr. E. Drinkwater, the town engineer. Many permanent improvements were carried out, including storm and sanitary sewers with manholes and gullies for house and street drainage, sidewalk and street pavement and covering works. Plans and estimates have been completed for a sewage disposal plant, and the plans have been approved by the Provincial Board of Health. These provide for the disposal of sewage by sedimentation and disinfection, and land is available for further treatment when required by the Board of Health. The plans also provide for the pumping of sewage out of mains at the plant. Pump houses, screening chamber, and disinfecting chamber will be built to provide for the ultimate requirements of the town, and the tanks built to take care of at least 100 p.c. above the present requirements.

A deputation from the building trades appeared before the Toronto Board of Control last week. With a view to ameliorating the unemployment, suggestions were made for the continuation of the filtration plan at the Island, the pumping station, and the registry office. The building of public lavatories was suggested, the fitting up of an assembly hall, the work on the North Toronto sewers, the incinerator plants and other matters.

Hon. Martin Burrell, Minister of Agriculture, has left for San Francisco to officiate at the formal opening of the Canadian building at the Panama Exposition. More than one million dollars has been spent on the Canadian exhibit, exclusive of another million or so spent by the Canadian railway companies on special exhibits. The exhibit by Canada is by far the most pretentious of any yet undertaken at similar Expositions.

The new Birks Building, Vancouver, B. C. Architects, Messrs. Somervell & Putnam.

Considering the obstacles which had to be faced, remarkable progress was made in the construction of the Hudson's Bay railway last year. The road is now completely graded to mileage 240, and partiallly graded to 54 miles further on. The track has been laid to mileage 214 and the trains are able to run to this point. A telegraph line has also been built to mileage 175. It is expected that the road will be completed to Port Nelson in 1915, and the tracks and other equipment placed in readiness for the 1916 crop. The Hudson's Bay railway is probably the most direct line for the distance in Canada. From Le Pas to Port Nelson is 424 miles, and this is only 22 miles longer than a direct air line.

The Montreal Trades and Labor Council requested by letter to the Board of Control last week, that in paving the streets the city should use only Canadian granite cut in Canada. Controller Cote referred to a recent report by City Engineer Mercier, after a visit to the United States, to the effect that the use of blocks of stone or scoria for paving streets along which a great deal of traffic passed would probably be abandoned very soon, and that, contrary to former opinion, a pavement in asphalt was better than one in granite as long as the foundation was good. Repairs on the surface would be all that would be necessary to keep an asphalt road in permanently good condition.

British Columbia mills are now tendering on one of the largest lumber contracts ever opened for world-wide competition. Through the British Government the Chamber of Deputies of France is asking for a supply of 500,000,000 feet of lumber to be used in the construction of 100,000 two-roomed houses. These small homes are to house the section of France's population which has lost its all through the ravages of war. It would not be surprising if one of the British Columbia mills secured the contract. This would be one of the greatest booms the lumber-cutting plants of this province had ever received. Owing to the fact that the French Government will want the lumber as early as possible, it will most likely mean that the firm which secures the contract will have to let sub-contracts.

The Kennedy-Stroh Corporation

Plans have been completed for the organization of the Kennedy-Stroh Corporation, Pittsburgh, which will take over the plants of the Best Manufacturing Company at Oakmont, near Pittsburgh, the Stroh Steel Hardenng Process Company, the Lawrence Steel Casting Company, Pittsburgh, and all the rights, processes and factories of the Kennedy Manufacturing & Engineering Company, New York City.

The Best Manufacturing Company occupied an extensive plant for the manufacture of power piping, flanges, fittings and valves, the buildings having been erected several years ago by the Crane Company of Chicago, but which the latter never used. For several years a good part of the output of steel castings of the Lawrence Steel Casting Company has been taken by the Best Manufacturing Company. The Stroh Steel Hardening Process Company has a method of casting two kinds of steel in one solid casting in such a manner that the hard alloy comes only on the part that is subjected to wear. The Kennedy Manufacturing & Engineering Company is engaged in the manufacture and erection of mining and crushing machinery, a specialty of the company being heavy gyratory crushers; it also builds complete cement-making, crushing and mining plants, while its engineering department prepares plans for the building of such plants. The Kennedy-Stroh Corporation has a capital stock of $1,600,000 and bonds of $750,000. It is stated that the company already has orders for more than $1,000,000 of its products.

It is of interest to refer to the modern steel-clad incinerator made by the Toronto Furnace & Crematory Company, Limited. This incinerator contains many valuable features which are described at length in an interesting booklet just to hand. The features are patented by the company and apply only to their particular incinerator construction. Their incinerator possesses in compact form every requisite for the sanitary reduction of all kinds of offensive and dangerous refuse. It is worthy of note that the company's practice requires that the incinerator shall be capable of reducing unmixed garbage and animal matter in any condition to saturation, and in any weather conditions, up to its full rated capacity, and to do the work with the minimum cost of fuel and labor. The company will be pleased to furnish their catalogue.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Berty Township, Ont.
The Township Council will call for tenders in one month for extensions to Point Abino March Drain, estimated to cost $3,000. Engineer, L. A. Kinnear, Port Colborne, Ont.

Chatham, Ont.
The City Council contemplate laying 2,700 ft. of 6-in. watermain for fire protection. Work to start in the spring. Estimated cost, $1,600. Engineer, F. P. Adams.

Ladysmith, B.C.
The Town Council contemplate laying ing $25,000 for street paving. Clerk, N. A. Morrison.

London, Ont.
Work will start at once by day labor on storm sewer between Oxford and St. James Streets, on Talbot Street. Estimated cost, $2,100. A. J. Brazier is Acting City Engineer.

Manager H. C. Glaubitz is preparing plans for installation of pumps and hydraulic equipment at Springbank pumping station. Estimated cost $30,000.

The City Council will apply to Legislature for permission to raise $50,000 for construction of trunk sewer to connect with new sewage disposal plant.

Montreal, Que.
City Council have voted $798,250 for construction of sewers on various streets this year. Tenders for sewer brick will be called for. Secretary, L. N. Senecal.

Tenders will be received until March 2nd, by Secretary to City Council, for supply of curbstone. Specifications, etc., at office of Superintendent of Purchase and Sales, City Hall.

North Bay, Ont.
By-law to raise $60,000 for improvement to streets was defeated on February 15th.

Paris, Ont.
The Town Council contemplate erection of two plants for purification of water with ozone, each having capacity of 9,900,000 gals. per day. Clerk, Thos. McCosh.

Peterborough, Ont.
Tenders will be received until 5 p.m., February 24th, by Chairman of Board of Works, Mr. G. Walter Green, Simcoe Street, for supply of sewer pipe and Portland cement. Specifications from City Engineer.

Sackville, N.B.
By-law to raise $40,000 for improvements to sewerage and watermains system will shortly be voted on. Clerk, Thos. Murray.

Stamford Township, Ont.
The Township Council contemplate laying pavements in spring. Engineer, J. C. Gardner, Queen Street, Niagara Falls.

St. Mary's, Ont.
Perth County Council will construct drain to cost $900. Tile and traps for manholes will be purchased.

Toronto, Ont.
Tenders will be received until March 2nd by Board of Control, for laying of asphalt pavements with concrete curbings, on Queen Street East. Plans at office of Commissioner of Works, R. C. Harris, City Hall.

Vancouver, B.C.
The Board of Health has recommended to the City Council, extensive additions to the sewerage system. Engineer, F. L. Fellowes.

Vernon, B.C.
By-law has been passed to expend $105,000 on construction of sewers and sewage disposal plant. City Engineers, Messrs. Cummons & Agnew.

Victoria, B.C.
City Council contemplate paving Cormorant Street from Quadra Street to Blanshard Avenue.

City Council have authorized Board of Works to start construction of sewers on Seaview Avenue. Estimated cost, $2,500. Engineer, C. H. Rust.

The paving of Cowichan, Quamichan, Richmond and Bank Streets is contemplated.

Winnipeg, Man.
Tenders will be received by Board of Control up to March 1st, for construction of sewers on Airlies, Mountain, Pine, Lorette, Carter and Marlin Streets. Secretary, M. Peterson.

CONTRACTS AWARDED

Niagara Falls, Ont.
Contract for trenching and back filling for service mains, etc., during 1915, has been awarded to Louis Sacco, Niagara Falls South. Earth, 65c. per cubic yard; rock, $5.50 per cubic yard.

Peter Lorezo, Niagara Falls Centre, has secured contract for laying sewers on part of Hamilton Street. Balance of work to be done by day labor, under supervision of Engineer, F. J. Anderson. Amount, $2,254.

Toronto, Ont.
The contract has been awarded to the John Inglis Company, Limited, 14 Strachan Avenue, for two electrically driven centrifugal pumps for the main pumping station. The price is $13,250.

Railroads, Bridges and Wharves

Caledonia, Ont.
Tenders will be received until March 6th, by Chairman of Roads for County of Haldimand, for construction of footpath, 600 ft. long and 4 ft. wide, on each side of Caledonia bridge over Grand River. Specification from Chairman, Mr. Harry Buckner.

Hamilton, Ont.
Temporary alterations will be made to King Street Station for Grand Trunk Railway. Approximate cost, $2,000.

Moncton, N.B.
Tenders will be received until noon, March 31st, by Minister of Provincial Government Department of Public Works, Fredericton, for construction of masonry work for bridge over Petitcodiac River, between Moncton and Cloverdale. Work includes masonry abutments and four masonry piers, and stone and earth approaches. Plans and specifications from Structural Engineering Company, Limited, 503-7 New Birks Building, Montreal; Board of Trade Rooms, Moncton; Provincial Government Rooms, St. John, and Department of Public Works, Fredericton.

Province of Alberta
The Engineer of the Edmonton, Dunvegan & B. C. Railway, St. Albert Trail, Edmonton, is preparing plans for steel and concrete bridge over Big Smoky River, to be completed this year. Tenders will be called for about August 30.

Saskatoon, Sask.
The City Engineer has recommended re-flooring traffic bridge with creosoted wood block, re-surfacing foot bridge, and painting foot bridge over C. N. R. tracks. Engineer, J. Jonsson.

Toronto, Ont.
Tenders close on March 2nd for sewers on Carlton, Dundas & Maclennan Streets. The plans are at the office of the Works Department. Mr. R. C. Harris, Commissioner of Works.

A macadam roadway will be laid on Main Street at an estimated cost of $15,000. Engineer, Mr. N. W. Hicks.

Deputation has applied to Provincial Hydro-electric Commission for survey and estimates for Radial Line in Whitechurch Township, York County. Engineer, Mr. Gaby, Continental Life Bldg.

Vancouver, B. C.
Vancouver Terminal Railway Company is applying to Federal Government for incorporation and power to construct railroads in Vancouver, New Westminster and at mouth of Fraser River. Solicitor, J. B. Noble, 402 Pender Street West.

Walkerville, Ont.
City Council have received a proposal from Pere Marquette and Grand Trunk Railway Companies to erect station on east side of Walker Road. Chief Clerk of Grand Trunk Railway, C. P. Powell, Sandwich Street E., Windsor.

CONTRACTS AWARDED

Brantford, Ont.
Contract has been awarded to P. H. Secord, 133 Nelson Street, for erection of station for Lake Erie & Northern

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The War Tariff and the Canadian Steel Industry

It is more than likely that the special war tariff which the Canadian Government has placed upon steel imports will lead ultimately to considerable expansion in the Canadian industry. The general tariff imposed is 7½ per cent., with a preferential tariff of 5 per cent. for Great Britain. This should be sufficient to give Canadian manufacturers an appreciable lead and induce them to take enterprising measures to secure the trade a considerable portion of which hitherto has been enjoyed by Germany and the United States. The revised scale will hardly find favor with those who have been importing steel in quantities, but the temporary disorganization of trade will be amply compensated for if it leads to the production of the higher grades of steel in Canada and the shutting out of foreign products.

An Appreciation from Sir Thomas Shaughnessy

The Canadian Pacific Railway Co.
Office of the President.

Montreal, February 23rd, 1915

Editor Contract Record:

Your British Empire Number of The Contract Record is very attractive and excellent, particularly the Symposium on Trade Development. The importance of impressing upon our manufacturers the necessity for such economy in the initial cost of production, while maintaining the highest standard of quality, cannot be over-estimated if the "Made-in-Canada" movement is to be effective, as it should be.

With the great demand on our factories during the last few years of abnormal activity, it was natural that work should be rushed out so as to meet the demands of customers without sufficient regard to the character of the output. Where this has occurred there is opportunity now to apply corrective measures and methods, and I have no doubt that generally this will be done.

One of our officers tells me that in the smaller shops, where shells are being manufactured in whole or in part, the accuracy and nicety of the workmanship demanded by Government Inspectors has had a most beneficial effect on the shop practice generally.

Yours very truly,
T. G. Shaughnessy,
President.

One special line in which it is held that the new tariff will open up a new industry is in steel tires for railway locomotives. Before the war we were buying a great proportion of our locomotive tires from Germany, although some of the railroads were placing orders for a higher grade but more expensive tire in Great Britain, and some orders went to the United States. Albeit, the old order is giving place to the new, and Canadian steel founders will now have the opportunity to produce all the supplies required by the Canadian railroads.

An optimistic view of the situation is taken by one prominent man who is well known to many of our readers. We refer to Mr. M. J. Butler, Managing Director of The Armstrong-Whitworth Company of Canada. Mr. Butler tells us that his firm has already started the manufacture of high-grade steel goods at its plant at Longueuil. At present, steel tires for locomotives are not being made, but the company is turning out the special grade of steel required, and doubtless the new line of goods will be manufactured shortly. Mr. Butler expects the war tariff to result in the production of many steel supplies in Canada which have been imported hitherto, and he is confident that constructional work and Canadian business generally will be benefited considerably.

In this superficial aspect the revised tariff would seem to open up great opportunities. There may be deeper, and perhaps more important, phases, such as cost, manufacturing facilities, and so on, but a solution to these problems will be found in the long run. Generally, we believe the tariff to be a useful measure in the respect that it will compel Canadian steel founders to sit up and take notice of the opportunity and demand for additional enterprise at this stage of the country's development.

It will be interesting to learn from Mr. Butler in due course just what steps The Armstrong-Whitworth Company are taking to meet the emergency of the new situation opened up by this tariff.

Engineering Topics in the Old Land

Question of "Hours" in Engineering Offices—Wastage of Skilled Material: A Sidelight on Recruiting Methods—Earthquake-proof Building Construction

By the London, Eng., Correspondent of The Contract Record

THE agitation for superannuation and security of tenure among English municipal engineering officials having been temporarily abandoned (owing to the war, of course) the red banner of an eight-hour day has been unfurled. It has been a one-man procession so far; but success having crowned its efforts we may look for agitation in other directions. The engineer in question was wearied of the fresh burdens being placed upon him from time to time, and he struck against working from 6.30 a.m. to 11 p.m. In the opinion of a certain section of his council, an engineering official should have no definite hours, and should be prepared to carry out as many duties as his council care to impose upon him. The majority of the council appear to have differed from this view, and on the engineer's request for his official hours to be fixed they decided on 9 to 5 daily, with a half-day off on Saturday. This may be all very well as far as it goes, and it will look very well upon the brass plate at the door or the wire blind at the window. But it won't pan out in practice. Council and committee meetings are not always held in the day-time, and works will go wrong and weather will go wrong, and a hundred and one things arise in the year calling for the early or the late services of the man-in-charge.

Official Hours

The writer was at one time in charge of a large rural district, and the whole of his duties had to be performed on a push bicycle. An ordinary day's outdoor work might mean anything from ten to thirty or even forty miles, with calls and inspections at frequent intervals, and when the snow was on the ground, or the roads had just broken up after a frost, or when a gale (or even a stiff breeze) was around, or when punctures were frequent, or even (to be quite truthful) the enticement of something hot led one into congenial company, eight hours would not suffice for the outdoor work alone. The engineer referred to is, however, in a small urban district (smaller than any that the writer has been in) so the question of travelling would not affect him, but as a set off he is the general factotum holding the offices of highway and water engineer and sanitary inspector. Such being the case he can scarcely expect to have an hour a day to call his own. Builders will be knocking in the early morning, ratepayers clamouring in the late evening, while the shop-keeping and artisan members of his council will pin-prick him on every available opportunity. A broken gas-mantle may mean a deputation to his private house, while a wrongly turned swan-neck or a leaking hydrant may lash the "High Street" into fury and cause an impromptu committee meeting in every local "pub," with a further deputation after closing hours. If the engineer would preserve the integrity of his "off" hours, he must reside out of his district—preferably, say, some 150 miles away! In no part of the world—Canada, Africa, Australia, India, or anywhere else—can a municipal engineer holding a chief (or the sole) position work to regularly defined hours. He must give and take—giving practically all and taking just what he can get.

Wastage of Skilled Material

Mr. J. D. Watson, the retiring president of the Institute of Sanitary Engineers, has passed some strong strictures on the method of recruiting for the 2nd London Sanitary Company of the Royal Army Medical Corps. The work of this company is popularly supposed to be the supervision of the sanitation and water supply of camps and billets and the reporting and remedying of defects; and the retiring president of the Institution of Municipal Engineers (among others) has been asking his fellow members to seize this "grand opportunity" to join a real live corps. A number have joined, and we now have Mr. Watson pointing out how misleading it has been to call for trained engineers as recruits. "The class of man the War Office need, is," he says, "the laborer and the navvy, the work being of the most menial nature. Unless in exceptional cases, it is unlikely that the men will be called upon to superintend or direct the work of scavenging camps," simply for the reason that the "engineers, architects, surveyors and sanitary inspectors" will themselves have to do the actual work. Mr. Watson hits the mark when he calls recruiting for such a purpose "a deliberate waste of skilled material which the country can ill afford at such a time." The application of this warning to Canadians may not seem very apposite at first sight, but the writer has had more than one letter from the Dominion in which the question is seriously asked, "Is it worth my while coming over to England and joining such a body as the 2nd London Sanitary Corps?" His reply is that while there is a town in Canada improperly scavenged, it would be a waste of time to cross the ocean for the sole purpose of wielding a broom and shovel. In other directions, too, there has been far too much wastage of skilled material.

Loans for Reinforced Concrete

The question of periodicity of Government loans to local authorities for plain concrete and reinforced concrete works respectively, still agitates the official mind. It does certainly, at first glance, seem an anomaly that the better class of work should be granted the lesser period of ten years (extended to fifteen in very exceptional cases) while the other should be granted twenty years. But a fuller inquiry into the matter would seem to justify the attitude of the English Local Government Board. In ordinary concrete work the main feature is solidity. In reinforced concrete work mere solidity is reduced to a minimum, and stability rests to a very great degree upon workmanship. The cement may be of the best, the aggregate most carefully selected, the mixing performed according to the most scientific methods, the rods and bars positioned with mathematical exactitude; but careless workmanship may work havoc in spite of every precaution, and only by the closest supervision can good workmanship be secured. There may, of course, be careless workmanship with ordinary concrete, but its evils are not so marked, for the margin of safety is a big one. In reinforced work this margin is considerably reduced. It is asked why, if the War Department, the Admiralty and the Office of Works use reinforced concrete, the Local Government Board also cannot do so. And the reply is not a difficult one to give. Work done by the three first-mentioned departments is carried out under the direct supervision of qualified engineers, and the fact that there are many duffers does not alter the case as there is always an experienced clerk of works. In municipal work (in England) there are more duffers than qualified engineers, and clerks of works are few and far between, owing to the parsimony of local authorities. It may be argued that in the case of important works in small districts an outside engineer is invariably engaged, but the evils then are, if anything, aggravated, as his visits will be few and far between, and ultimate reliance has to be placed upon the contractor and his clerk of works. The Local Government Board are wise in their discouragement of the use of reinforced concrete; indeed, no loan at all should be granted unless competent supervision can be assured.

Earthquake Buildings

The recent appalling disaster in Italy once again brings up the question of the construction of buildings against earthquake damage. In one of the illustrated papers has appeared a photograph of Orsini Castle, Avezzano, which was built in 1400. The walls of the castle were 6-ft. thick, but despite this, the report says, "it was destroyed," An inset to the picture gives a photograph of a humble reinforced concrete house—a two-storey building with a door in the centre and a window on either side—and this remained intact. Doubtless a careful investigation will be made and the relative merits of reinforced concrete, steel-frame; masonry and timber buildings will be fully discussed. An exhaustive report was prepared on the San Francisco earthquake and fire in 1906 by Mr. A. L. A. Himmelwright, M. Am. Soc. C. E., acting on behalf of the Roebling Construction Company of New York, and the following points gleaned from his report are of distinct interest. The effect of the earthquake was to shake down about 95 per cent. of the chimneys within the area affected. The great majority of the buildings in the area were two to four storeys in height with shallow foundations. When erected on compact, original soil, there was little damage or displacement to the foundations; but when located on soft, incoherent material, the foundations were invariably more or less displaced and the building tilted out of plumb. Well-designed and well-executed wood or frame buildings were but slightly injured by the earthquake. The toppling over of the chimneys and cracks in the plaster finish and cellar walls usually represented the total damage. Sometimes such buildings were shifted a trifle from their original positions on the foundations. Even where the foundations were affected, the damage was usually confined to plaster cracks and a slight racking of the frame, and was always less than in the ordinary brick or stone walled structures. "Balloon" or continuous frames showed the best results. When the different storeys were framed separately and well tied and braced, the results were equally good. The few framed buildings that collapsed lacked suitable ties and braces, or were of flagrantly poor construction. Buildings with masonry walls of stone or brick generally sustained considerable damage. In many of the so-called "fireproof" buildings, the walls were self-supporting, being simply built around the steel frame which supported the floor loads. In these buildings the walls were sometimes shaken loose from the steel wall columns and occasionally fell out or remained in a dangerous condition. Buildings with steel skeleton frames and curtain walls (i.e., walls supported by the steel frame) generally sustained the earthquake shock without structural damage.

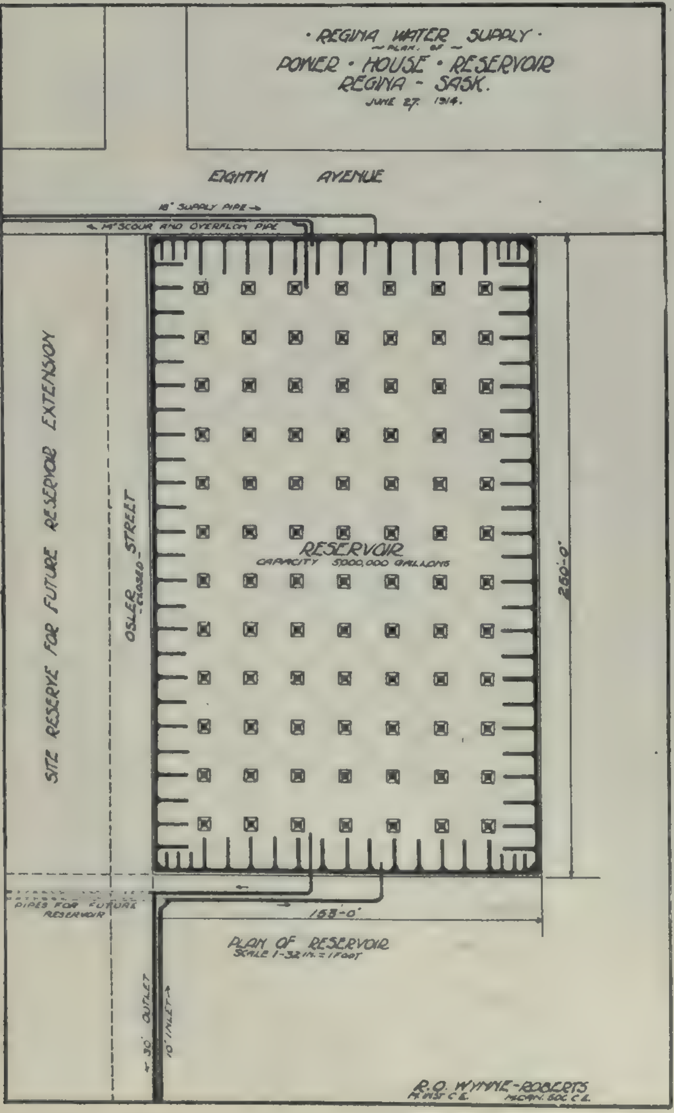
Steel Frame vs Reinforced Concrete

Mr. Himmelwright was not, in 1906, an advocate of reinforced concrete construction, and his strictures upon the material were of a somewhat partisan nature. "Enthusiastic persons in favor of concrete construction, and interested contractors," he said, in the report referred to, "have recently published and disseminated much reading matter advocating buildings constructed entirely of reinforced concrete as a type well adapted to resist earthquake shocks. Much of the information and many of the statements so published are misleading. It would therefore seem appropriate and necessary to sound a note of warning and conservatism to those who contemplate the erection of buildings of this class in sections subject to earthquake disturbances. In typical reinforced or armoured concrete buildings, not only the walls and the floors, but also the columns, girders and beams are built of stone concrete reinforced with steel rods, bars, etc. The radical feature of doubtful expediency in these buildings is the substitution of reinforced concrete for the steel columns, girders and beams which are ordinarily used in the best practice in fireproof buildings. In reinforced concrete construction, however, slight displacements or settlements are of vital importance and a menace to the safety and integrity of the building. The light rods and bars which are ordinarily employed for reinforcing, and which are anchored in the concrete or simply hooked together, lack the positive rigidity, strength and tenacity of the standard steel connections, and would in no case withstand the same distortion without failure." His conclusion that the success and safety of reinforced concrete depends wholly upon the uniformly good quality of the cement, may now be universally agreed, but only with the added proviso as to good workmanship. The most useful paragraph in his report is that in which he says "in order that the superstructure may withstand earthquake shocks, it is absolutely necessary that the foundations be adequate and stable, and of sufficient strength to enable the entire base of a building to move as a unit." Surely, a reinforced concrete structure is just the one to answer this requirement.

The Design and Construction of the New City Reservoir at Regina

Specially Contributed by R.O. Wynne-Roberts, M. Inst. C.E., M. Can. Soc. C.E.

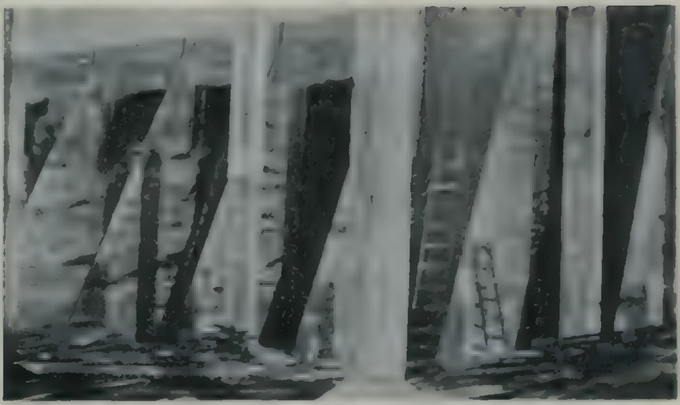
THE part of Boggy Creek watershed from which the city of Regina obtains its main supply of water is about seventy-two miles in area, and the nearest point is about six miles distant by skyline, or eight miles by road. The watershed has a pear-shaped boundary, the narrowest and lowest point being at the southwest corner, where the city owns land. On this land about forty-five artesian wells have been sunk. The water in all cases overflows the surface, and is collected and conveyed by underground pipes to Barton pump-well, which has a capacity of 270,000 gallons. In a pump house adjacent to the well there are two 80 h.p. Crossley oil engines, and two 2,000,000 g.p.d. turbine pumps to raise the water to Tor Hill reservoir, which was described in these columns about a year ago. This reservoir has a capacity of 5,000,000 gallons. It is built of reinforced concrete, is circular in plan, 202 feet in diameter, 25 feet deep, and stands about 90 feet above the pumps and about 120 feet above the city street level. The water is conveyed from this reservoir to the city by an 18-inch steel main, which has a maximum delivering capacity of about 3,500,000 gallons per diem. In an adjoining section are located a number of springs, yielding from 400,000 gallons upwards, according to the season. This constituted the only source of supply for the city until 1911, and was quite inadequate. This water is conveyed by 15-inch vitrified pipes to a basin half-way to Regina, and thence by a cast iron main, partly 12, but principally 10 inches, in diameter. The present total yield is from 2½ to 3 million gallons per day, but it is estimated that Boggy Creek area will yield up to four or five million g.p.d., by extending the collecting lines and sinking additional wells. The 10-inch supply is pumped into the city mains by an electrically-driven turbine pump, but the 18-inch ordinarily affords a gravity pressure of 45 pounds per square inch. When the demand is great and the pressure is diminished the water is pumped by a 5,000,000 g.p.d. Escher-Wyss turbine pump driven by a Bellis & Morcom high-speed steam engine.



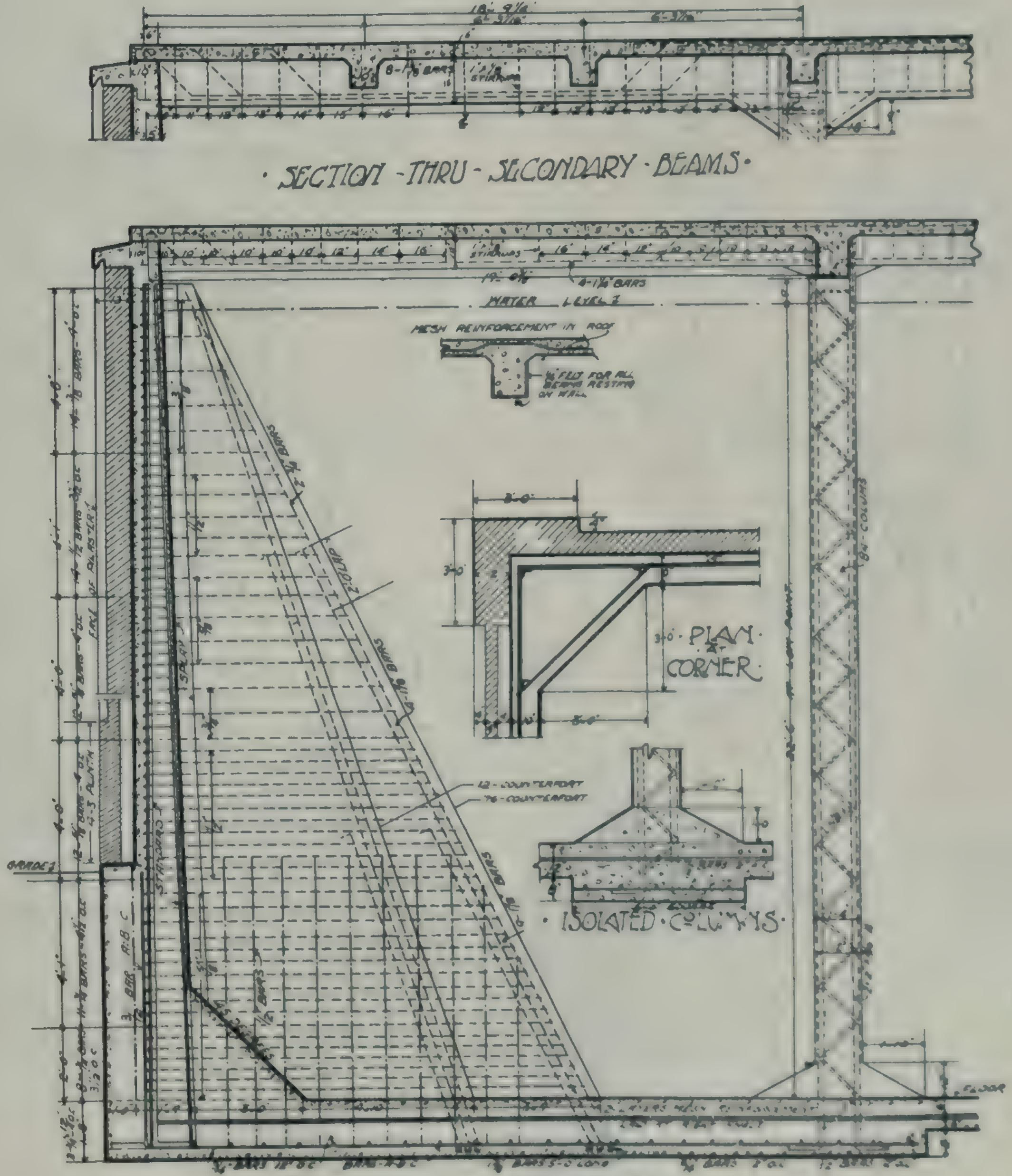
Additional Supply

The writer some time ago reported to the city council on the question of additional water supply, and recommended the adoption of a scheme which involved the taking of water from five watersheds contiguous to Boggy Creek, making a total area of about 200 square miles, and estimated to yield about 10,000,000 g.p.d. This scheme can be carried out piecemeal, provided the initial works are properly laid out. A part of the scheme was a 27-inch steel main to tap the Silver Stream area, with a branch to Tor Hill reservoir. As the existing mains from Boggy Creek were delivering the maximum quantity on the gravitation pressure system, it was deemed desirable to lay the part of the 27-inch main from Tor Hill reservoir to the city so as to supplement the quantity and pressure. The cost of the pipe-line was estimated at about $508,000, which was a large amount to incur under the prevailing financial conditions. As a city reservoir would be necessary even with such a main, City Works Commissioner Thornton considered that the reservoir would suffice for the time being. The

Concrete mixing for floor.



Construction of counterforts.



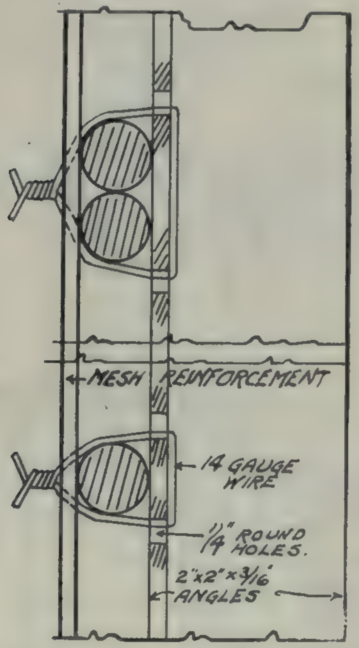
Typical section through wall, roof and floor.

supply to the reservoir is from the 10-inch line, and the night surplus from the 18-inch main.

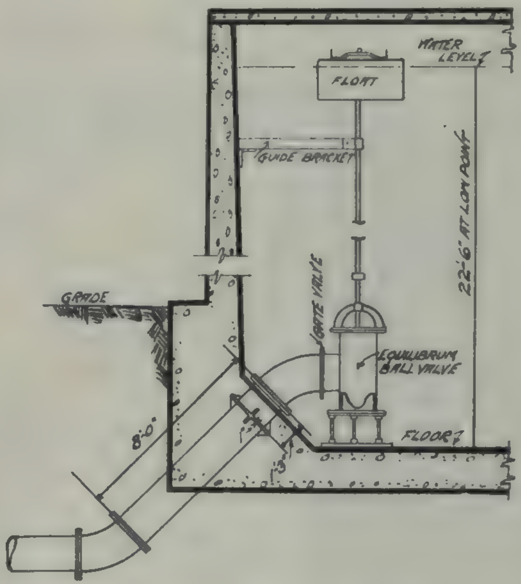
Having considered all points of the scheme, it was decided to build such a reservoir. There were two sites available—one near the cemetery, on which a duplicate of the Tor Hill circular reservoir could be constructed, and the other a piece of land near the power house. Having regard to the convenience of a reservoir near to the power house, and to obviate the cost of laying a large main from the other site, the power house site was selected. This land, however, was limited, and did not permit of embankments; consequently the writer designed a rectangular basin covering the entire site and part of a closed street, the length being 250 feet, the width 153 feet, and the water depth 22 feet. It has a capacity of 5,000,000 gallons, and was estimated to cost about $125,000, exclusive of the land. Reservation was made for a duplicate reservoir to be built in the future.

General Design of Structure

The site was practically level, and as it was advisable to assure a constant head on the turbine pumps, most of the reservoir had to be built above ground. The floor level is 6 feet below the ground surface, and the top water-line about 16 feet above. The work will be described in the order of construction.



Section showing method of fastening horizontal rods.



Elevation of 18-in. inlet.

Excavation

It was intended to excavate the ground by machine, but in order to afford more employment it was done entirely by manual labor. The excavation extended about one foot beyond the wall-lines, and to an average depth of 7 feet 4 inches. The actual cost of labor was 46 cents, and team work 50 cents, per cubic yard. The material was entirely gumbo clay.

Floor

The floor for a distance of 22 feet inwards from the walls is 20 inches thick; the central portion is 12 inches thick, and under each column 20 inches thick. The reinforcements consist of ¾ inch round bars at 12-inch centres in the lower part of the thicker concrete near the walls, and these bars extend 8 feet up the walls to form the necessary tie. Half-inch round bars are also laid within 6 inches of the surface at 6-inch centres in two directions. These bars are tied with wire at every fifth intersection in one direction, and at every intersection in the other. The column bases have an extra layer of ½-inch bars at 12-inch centres in the lower portion. The concrete was laid to the level of the bars, and when these were placed the next portion of concrete was poured on, and finally a 2-inch finishing coat of fine concrete laid and trowelled to a close-textured surface. There is a fall of one foot from one end to the other of the floor, and a small fall from the sides to the major axis.

Walls and Counterforts

The walls are 33 inches thick at the base ,with an addition of a splay on the inside of 36 inches. There is a set-back on the outside of the wall at the ground surface, and here the concrete is 14 inches thick, and at the top 10 inches thick. The external faces are vertical, but on the inside there is a batter of 11 inches in a height of 23 feet. There is an overhanging coping on top with a sloping surface to shed th water. The set-back and overhanging coping of 12 inches will be the base and finish, respectively, of a cellular tile wall, which will be explained further. The counterforts are 14 inches thick, and are located on the line of beams and intermediately, and their bases extend into the reservoir 11 ft. 6 in., and finish at 9 inches above top water level, the projection there being 12 inches. The counterforts at the corners are smaller, to admit of circulation of the water. The extreme corners were filled in solid to avoid complicated form work, etc. At the connections of the counterforts with the wall 6-inch splays are provided. Spaces are left in top of walls to receive beams, etc. The reinforcements were calculated on the assumption that the walls between the counterforts were acting as simple beams, having depths equal to the thickness of the walls, and a uniform load equivalent to the varying depths of water. The horizontal reinforcements are round bars varying in diameter and spacing to correspond approximately to the area of steel required—

at the base there are ¾-inch bars at 4-inch centres. These bars were cranked at the necessary distances, and the ends bent. As it was too troublesome a work to frequently change the cranking, owing to the reduced thickness of the wall, the changes were made at six points. The counterforts were calculated as cantilevers hinged at the base of the wall and tied to the floor at the toe, and are horizontally reinforced at the same spacing or multiples thereof as the wall, but the diameters are less. The tension bars connecting the toe to the floor consist of nine 1⅛-inch round bars, linked round bars of same diameter, inserted crossways in the floor concrete. These bars extend upward for one-third the height; there the number is reduced to four, and from two-thirds height to top there are two ¾-inch round bars. The overlaps are two feet, with the ends of bars all bent. The horizontal bars connecting the tension bar to the wall are bent into horizontal hooks to slip over the tension bar and vertical bends to fall over the wall bars. There are ½-inch round bars at 12-inch centres vertically connecting the counterforts with the floor. To provide for temperature stresses, continuous triangular steel mesh reinforcements are inserted within about three inches of the outside face.

As it was most important that the horizontal wall reinforcements should be placed where designed, and held there during the process of concreting, the writer adopted practically the same method as on Tor Hill reservoir. Vertical standards consisting of 2 in. x 2 in. x 3/16 in. angles are located one at each buttress and two between. Two holes were drilled on one web to receive each bar, and a soft wire inserted through the two holes to bend the bars in place at the required distances apart. This method fixed the bars permanently, and although men climbed up and down, no movement took place. The reinforcements and supports gave the impression of a secure steel basket work. All overlaps of wall reinforcements took place at the junction of the counterforts with the wall.

Columns

The 84 columns are 18 ft. 9 in. apart in one direction and 19 ft. 0-⅜ in. in the other, and are 16 inches square, resting on pyramidical bases; and the height from the top of the base to the underside of the beams is 21 ft. 9 in., or slightly over 16 times the least dimension. It is somewhat difficult to assure true alignment and perpendicularity for a vertically-cast column of this height, and to prevent any bending the reinforcement consisted of 2 in. x 2 in. x 3/16 in. steel angles tied together with 1 in. x ⅛ in. flat iron rivetted at 24-inch centres, which proved to be very satisfactory.

Roof

It was intended to construct the roof entirely of reinforced concrete to carry a live load of 200 lbs. per square foot, and careful designs were prepared for this purpose; but owing to a suspension of the work caused by financial disturbances due to the European political situation, much time was lost, and it was necessary to adopt a quicker method of construction. Consequently steel joists were substituted for the reinforced concrete beams. The primary beams run across the reservoir, and the secondary beams lengthwise. The primary beams are 18 ft. 9 in. long, and rest on the columns, and the secondary are 19 ft. 0-⅜ in. less the thickness of the primary web, and are secured together by standard angle connections. The secondary beams are 6 ft. 4 in. apart. The roof concrete floor is 5 inches thick; it rests on the steel beams, and is reinforced with No. 31A continuous triangular steel mesh 54 inches wide, with overlaps of 4 inches. The work of concrete has had to be suspended owing to the frost, and will be completed in the spring. Manhole covers at each end and four ventilators were inserted in the roof. The roof has a fall of 12 inches from the middle to the ends, and rain-water outlets are provided to carry off the surface water. The roof beams and concrete are disconnected from the walls by a thick layer of felt, so as to obviate any stress induced by temperature contraction or expansion being applied to the walls.

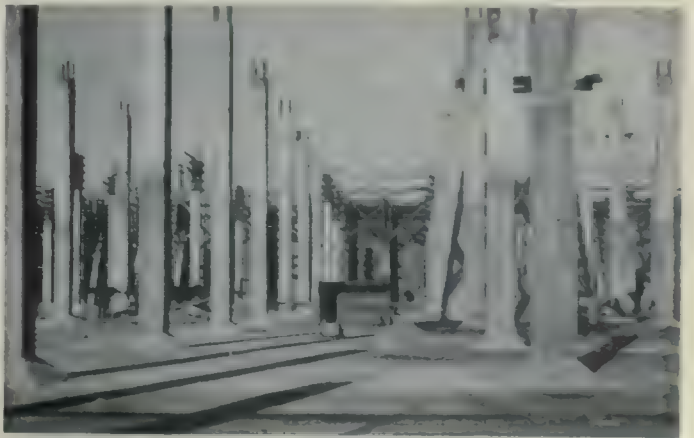
Wall reinforcement.

Waterproofing

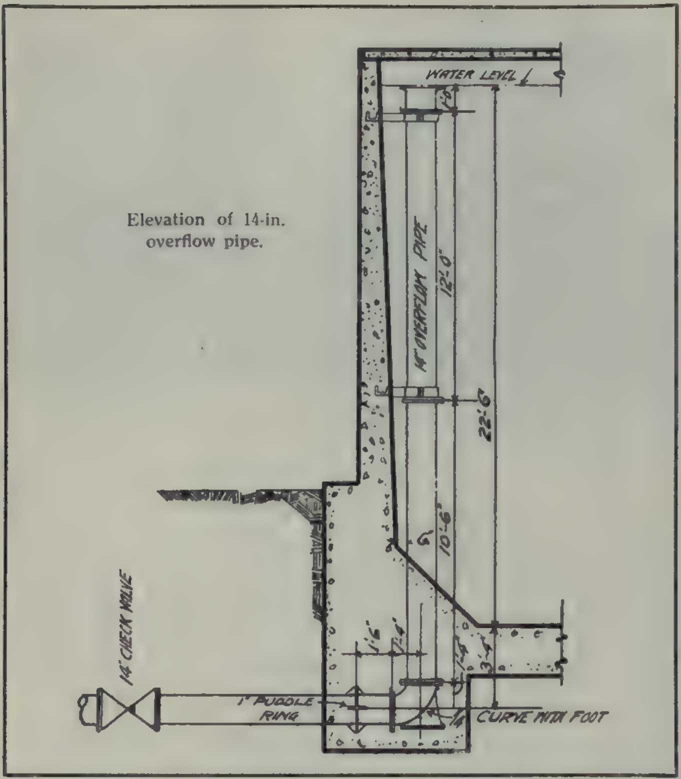
No waterproofing compound was used with the concrete, but when the walls were dry a thick layer of hot liquid bitumen was painted on, and afterwards coated with neat cement cream. This process was found to be effectual in the Tor Hill reservoir, and was again applied in this case. The roof will be coated in a similar manner.

Concrete Mixtures

The cement was supplied by the Canada Cement Company, and the gravel was obtained from the city gravel pits, supplemented by some screened gravel from the neighborhood. The pit gravel was tested before the work was started, and found to be fairly uniform. No screening was done. There are railway spur tracks at each end of the reservoir, which were found to be very convenient, for the gravel was shovelled into the hopper, cement added, and the whole mixed by Ransome mixers. Five bags of cement per cubic yard of gravel were used in the floor, six bags in the walls,



Column construction.



Elevation of 14-in. overflow pipe.

8½ bags in the columns, eight bags in the roof, and 6.3 bags per cubic yard in the floor finish.

Drawings

The drawings were so prepared that the nature of the reinforcements in every part of the work could be seen—that is, the position of the cranks, bends, overlaps, etc., were shown, and the number of bars, diameters, lengths, and weights were given. When the work was being carried out the cranked bars fell into their allotted places and then were fastened by wire. The work proceeded methodically from start to finish, and doubtless this contributed considerably to the economies effected—for there was very little loss of labor and materials, the work having been pre-arranged.

Placing Concrete

As the concrete was mixed it was conveyed in ordinary two-wheel tipping concrete carts over runways erected from time to time in the most convenient positions. Men were employed in slicing the concrete in place, and care was taken to assure that the steel was properly covered.

Drains

An 8-inch sewer pipe was laid outside the base of the walls to remove any water that may collect there, and also to conduct the rain-water to the sewer.

. Form work.

Tile-facing

As the land occupied by the reservoir was limited and expensive, it was essential that the fullest possible use should be made of it. Consequently embankments had to be eliminated and the walls supported internally —hence the reason for using counterforts. Owing to the absence of external protection such as would be obtained by embankments, steps were taken to insulate the wall against temperature in another manner. After due consideration, the method that was deemed expedient was the construction of an external cellular tile facing. Ties have been left on the outside of the concrete walls to bind the tile-facing to it. The facing has been designed to produce a pleasing effect by providing pilasters and recessed panels. The winter arrived before this work could be undertaken, and consequently it was held over until the coming spring weather.

Iron Work

Inlets.—There are two inlets, one at each end, one 18 inch and one 10 inch. This is because of local conditions. Each inlet is provided with a sluice-valve on the outside of the reservoir, and a Glenfield & Kennedy equilibrium ball valve, which will control the height of water at any pre-determined level. As previously mentioned, the 18-inch inlet will discharge the surplus night flow, and to assure the city a pressure a Glenfield & Kennedy loaded equilibrium valve with bypass has been inserted on this main, and so adjusted that no water will discharge into the reservoir until the new pressure has exceeded a fixed point. In other words, the equilibrium valve will act as a relief, and when the water level has reached a definite position the ball valve will shut off the supply.

Outlet.—There is one 30-inch bellmouthed outlet at the upper end of the reservoir, and this is connected with the pumping plant in the power house close by. All valves on this line are 24-inch, with taper pipes at each end.

Overflow and Scour.—These are located at the lower end of the reservoir. The overflow pipe has a bellmounted top, and is 22 ft. 6 in. above the floor at that point. It is secured to the wall by 4 in. x ½ in. steel stays. The scour pipe, also 14 inches diameter, is situated in a sump 3 ft. deep. The overflow and scour run into one pipe outside the reservoir where the valves are located. All external valves are provided with chambers. Ladders are constructed of 4 in. x ½ in. steel stringers and ¾-in. rungs 15 inches apart, and 18 inches long.

Puddle Rings.—All cast-iron pipes, bends, etc., inserted in the concrete work were provided with 6 in. x 1 in. puddle rings cast on with brackets, with the view to preventing water seeping along the pipework.

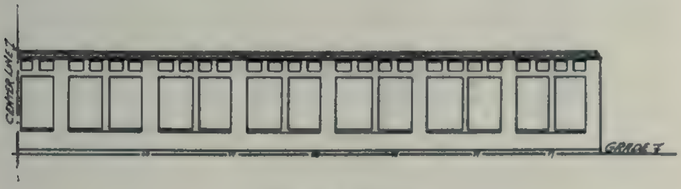
Power House Connections

Inasmuch as it was important to provide adequately for fire extinction, the writer advised that the connections between the city reservoir and the pump should be made as large as possible, to suffice for some years, and in the interval the additional 27-inch main from Tor Hill reservoir, already referred to, would doubtless be constructed.

The basis of the calculation in connection with computing the quantity of water required for fire extinction purposes was the formula suggested by the American National Board of Fire Underwriters, which is: $Y = 850 \sqrt{x}\,(1 - 0.01 \sqrt{x})$ in which Y represents

Imperial gallons per minute, and X represents the population in thousands.

The pipe arrangement at the power house consists of one 36-inch supply main fed by the 18-inch main from Tor Hill reservoir, and 30-inch pipe from the city reservoir, and one 36-inch delivery main. These are parallel, and only a few feet apart. When the gravity supply and pressure from the 18-inch main is ample (supplemented by the 10-inch supply which hitherto had to be pumped) the water passes direct into the 36-inch delivery main; otherwise all water is conducted to the supply main and pumped at city pressure into the 36-inch delivery main. There is an outlet from the 36-inch delivery leading into a warmed underground chamber under the footway, and there it is divided into three distributing mains—a 24-inch to southeast district, a 24-inch to southwest district, and an 18-inch to the north district. Each of these distributing mains is so arranged that the connections in the chamber will allow one, two or three of the branches to be used simultaneously. On each branch there is a Glenfield & Kennedy pressure-regulating valve, which can be adjusted to any pressure, and each main has a Simplex Venturi meter. The pressure-regulating valves are normally out of commission, but when a fire occurs in any district two of the pressure regulators are put into action by simply opening small taps near the pump, and thus the fire pressure produced by the pumps is concentrated on the district from which the alarm was received. These regulators have lever arms carrying the weights which fix the outlet pressure, and the piston connected to the free end of the lever is operated by the outlet pressure, causing it to rise or fall, and in doing so an indicator in the power house is moved correspondingly, and thus the operating engineer can see at a glance what is taking place.



Side (half) elevation.

Each Venturi meter is connected to the power house by two wrought-iron pipes, which conduct the main pressure and the throat pressure to the recorder which indicates the rate of flow, records on a chart the varying flows, and also shows by a counter the total quantity discharged.

The credit for the neat and simple contrivance installed in connection with the regulator valves and Simplex Venturi meters is due to Mr. T. H. Smallwood.

Forms

The wall forms consisted of 1 in. x 8 in. sheeting supported by 2 in. x 4 in. uprights at 24-inch centres, tied and strutted to forms on the opposite face by soft wire. The counterforts were formed in a similar manner, except that the sloping face had 2 in. x 8 in. and splays 2 in. x 10 in. The runways were built of 6 in. x 6 in. verticals, 4 in. x 6 in. horizontals, and 2 in. x 12 in. surface boards.

Cost

As already stated, the estimated cost of the reservoir and connection was $125,000. The reservoir alone was estimated to cost $110,000, and the connections the balance. The total actual cost of the reservoir was $78,514.86, and the pipe connections $14,951.72—making a total of $93,466.58, or $94,657 inclusive of sundry expenses; so that a saving of at least $30,343, which is equal to 23.2 per cent. on the estimate, was effected by carrying out the work under the direct control of the Waterworks Department.

Itemized Cost.—It may be interesting to give a few of the itemized costs.

Labor, excavation	cu. yd.	.46
Labor, concrete mixing for floor	cu. yd.	.47½
Labor, concrete placing for floor	cu. yd.	.21½
Labor, concrete mixing, for walls	cu. yd.	.54
Labor, concrete placing, for walls	cu. yd.	.50
Labor, concrete mixing, floor finish	cu. yd.	.51½
Labor, concrete laying, floor finish	cu. yd.	$2.03
Labor, concrete mixing, columns	cu. yd.	.46
Labor, concrete placing, columns	cu. yd.	$1.22½
Labor, concrete mixing, roof	cu. yd.	.49½
Labor, concrete placing, roof	cu. yd.	.44
Labor, steel reinforcement in floor	per 100 lbs.	.16
Labor, steel reinforcement in walls	per 100 lbs.	.59½
Labor, steel angle standards	per 100 lbs.	.77
Labor, steel bending for walls	per 100 lbs.	.44½
Labor, steel mesh in roof		.20¾
Labor, form work, wall	per sq ft.	.05
Labor, stripping formwork from walls,	per sq ft.	.00¾
Labor, formwork for columns	per sq. ft.	.05¼
Labor, stripping formwork from columns,	per sq. ft.	.01½
Labor, formwork for roof	per sq ft.	.03
Labor, waterproofing walls	per sq ft.	.00½
Labor, cement washing walls	per 100 sq. ft.	.70
Labor, structural steel in roof	per ton	$2.94
Labor, placing column reinforcement,	per 100 sq. ft.	.70½

The walls cost for labor in placing concrete,

.30½ per cu. yd. for the first 9 ft. in height.
.47 per cu. yd. for the second 9 ft. in height.
$1.05 per cu. yd. for the third 9 ft. in height.

The City Works Commissioner, Mr. L. A. Thornton, took an active interest in the work, which was managed by Mr. J. M. MacKay, the Waterworks Superintendent. Mr. H. Gibson had charge of the execution of the work, while Mr. I. Ormond Riddell was the Resident Engineer, and Mr. Theo. Brockmann checked the design.

Revenue from sewage disposal is one of the subjects discussed in the "Surveyor's" annual review of progress in sewage treatment in England. It is stated that there are few places where any income is derived from sewage, and among these Bradford, Yorks, probably stands easily first. Although the total cost of disposal in 1913 was £89,000, the sale of grease alone brought in £48,000, while the sludge residue, after the removal of the grease, was sold in large quantities as manure, being sent to France, Belgium, Florida, and even as far as India for tea gardens on the slopes of the Himalayas. The revenue derived from the sale of these by-products more than covers the cost of operation, so that, apart from capital charges, the sewage disposal works are self-supporting.

Concrete should not be too wet or too dry. If too wet it will shrink an excessive amount in setting and hardening; if too dry when placed it will not be dense, as the mortar will not run into the spaces. It is better to use too much than too little water, but mixtures that are too wet are not so strong as medium mixtures.

Distinctive Features of the Lethbridge Sewage Disposal Works

By A. C. D. Blanchard, M. Can. Soc C.E.*

THE city of Lethbridge is situated on a level plateau about 250 feet above the Belly River. Lethbridge is the principal centre of population in southern Alberta, and has had a steady growth since the time of the installation of its first waterworks system in 1904. At the present time the population is about 12,000. With the extension of sanitary sewers the volume of sewage is rapidly increasing. The water pumped averages 1,300,000 gallons per day, and the waste returned to the disposal works is in the vicinity of 1,000,000 gallons per day. The city has a separate sewerage system, and three converging outlets bring all the sewage to the site of the works by gravity.

The disposal works recently constructed and now in operation is one of the first of its kind to be placed in operation in Canada, and it is proposed in this article to deal not only with the design and construction of the works, but also to offer criticisms and state certain conclusions which have been reached since the commencement of operations in the hope that these may be of some service in future problems of a similar character.

The plant, located on flat ground near the river edge, is ideally situated, being more than 200 feet below the settled portion of the city. The general design of the works was prepared by the consulting engineer, Mr. T. Aird Murray, M. Can. Soc. C.E., who was engaged by the city for that purpose; and after the plans had been completed, they were carried out by the author, then City Engineer. After the general design was made, a number of improvements were suggested by the author, and in addition certain other changes were made, having in view saving in first cost. All alterations were referred for approval to the consulting engineer.

The principal part of the construction was carried out under contract, this including all concrete work, the building of the chlorinating house, and the setting of all pipes and machinery. The filter machinery itself was furnished by Adams Hydraulics, Limited, of York, England. A contract was also executed between the city and the principal contractor to fill two of the circular filters with filter medium, some of which had already been placed near the site during the slack time of the previous winter. The city filled the third filter with screened gravel after the contractors were away from the ground.

In the design of the sedimentation tanks there was sufficient novelty to evoke considerable discussion at the meeting of the Dominion Health Commission in Montreal in 1911, and as a consequence some details of the design were altered, but the general type remained the same. The particular type of tank installed has been known as the "Lethbridge" tank. There is nothing unusual in the design of other parts of the plant, which is intended to treat the sewage of the city by preliminary screening, sedimentation, sprinkling filters and a further passage through small sedimentation tanks. The liquid thus purified is passed through a narrow baffle-race where chlorine solution may be applied.

Detritus Tanks.—The detritus tanks which contain the screens are in duplicate and have hopper bottoms, each equipped with a sludge valve. The screens do not reach to the bottom of the chambers. They are of ½-inch wrought iron with ½-inch openings. After passing through the screens, the liquid passes over a weir into a collecting channel, and is then distributed through two 18-inch pipes controlled by penstocks into the distributing channels of each sedimentation tank. The sludge or detritus in the compartment of the detritus chambers is intended to be disposed of through sludge pipes discharged by gravity into one of the sludge beds. Each detritus tank, in volume, contains 675 cubic feet. The liquid surface area is 120 square feet and the area of the screen, including openings, is 52 square feet.

Sedimentation Tanks.—The sedimentation tanks are in duplicate. They are covered with a concrete roof 6 inches thick, supported by 24-inch I-beams, excepting over channels, which are covered with removable creosoted planks. Throughout the length of each are two distributing weirs. The one first reached by the liquid is on a slope of about two inches in the length of one hundred feet, and the second weir is level. This latter weir is intended to equalize the flow so that the velocity of the liquid across any portion of the tank will be uniform, thereby causing the minimum of disturbance during settlement. Before reaching the collecting weir, the sewage is baffled by a 6-inch concrete wall with 4-inch holes near the bottom of it at intervals of three feet. The liquid passes through these apertures into the collecting channel over the weir. This channel averages 15 inches in depth, there being a bottom slope of 6 inches from end to end. The particles capable of settling during the period of flow in the tank are deposited on slopes of wire glass, and when they have accumulated in sufficient mass the solids slide down the slopes and under the glass apron into the sludge compartment. This apron is a distinctive feature of the Lethbridge tank, and consists of ¼-inch wire glass laid on 4-inch I-beams spaced 5 feet on centres. The apron has a slope of one foot in 3.3 feet, and completely covers the sludge chamber. The corresponding fore-slope at the collecting side of the tank is formed in concrete on solid foundations, in which the wire glass is imbedded to form a smooth surface. The slope of this portion is the same as that of the apron. Each tank is one hundred feet long and thirty-two feet wide. The period of flow for maximum capacity is practically two and one-half hours, and the maximum average velocity of flow is at a rate of .037 foot per second. The total contents and measurements of the various compartments are as follows:—

(a) Total capacity	34,000 cu. ft.
(b) Sludge capacity	10,133 cu. ft.
(c) Capacity above apron	16,475 cu. ft.
(d) Capacity between sludge line and apron	8,000 cu. ft.
(e) Liquid surface area	3,200 cu. ft.

Note.—Sludge capacity is taken up to toe of fore-slope.

The capacity of the sludge compartments of both tanks amounts to 20,266 cu. ft. Storage is provided for a period of three and one-half months, based on a separation of three and one-half cubic yards of liquid sludge to each million gallons of sewage. Each compartment has four hopper-shaped bottoms, a separate sludge valve being provided at the junction of the four slopes in each bottom. Two slopes of each hopper have a pitch of one in two and the other two slopes have a pitch of one in three, these variations being caused on account of the fact that the hoppers are not square. The top of the sludge compartment is, of course, formed by the glass apron previously mentioned, and this apron has sufficient pitch to allow gases which collect on the under side to pass to the extreme upper part of the apron, from which they are removed through small galvanized iron pipes. In addition there are two 9-inch vitrified pipes at the ends of each tank which also serve as outlets. The sludge valves open on a 6-inch cast iron pipe line running lengthwise with each tank, and after these pipes are carried beyond the wall of the tanks they meet a 9-inch pipe line leading from the detritus tank sludge chamber directly to the sludge beds. The stems operating the sludge valve extend through the glass apron to the roof and are exposed for use by removing small cast iron covers set in the concrete roof. One-inch water services direct from the city force main are connected to the end of each line of sludge pipes for the purpose of flushing, if desired.

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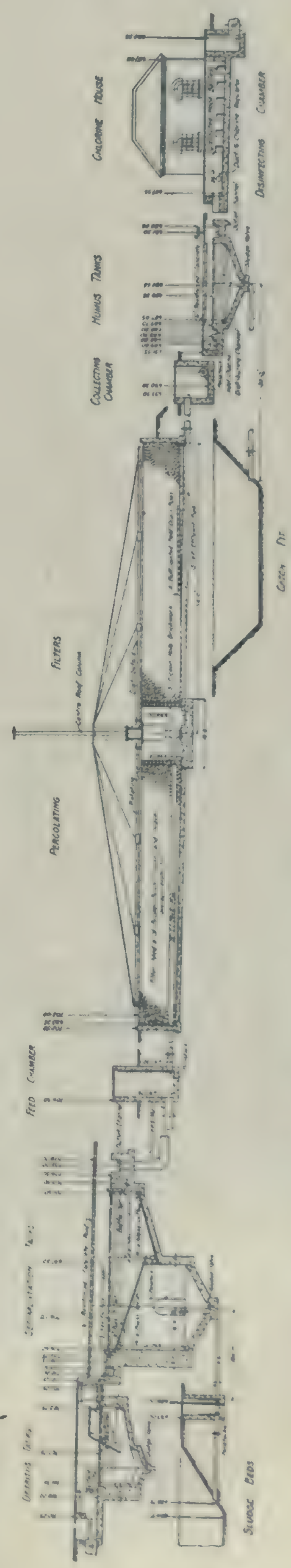
*Of the Greater Winnipeg Water District; formerly City Engineer of Lethbridge.

The collecting channel between the sedimentation tanks discharges into a cast iron pipe with a bellmouth on a level with the bottom of the channel. The sewage in entering this bellmouth is subjected to a natural vortex motion for the purpose of giving the the liquid a chance to draw down and absorb all the oxygen possible. This pipe, which is 21 inches in diameter, discharges into a distributing chamber in which are located the three controlling valves for each of the three filter units. The liquid passes through to either of the filters by means of 12-inch cast iron pipes laid along the bottom of the filter floors to the riser pipes at the centres of the filters. The filter apparatus is of the standard "Cresset" type. The sprinkling arms cover a circle, having a diameter of 108 feet, and are probably the largest yet installed in this country.

Filters.—The filters are three in number with concrete floors and have their surfaces exposed to the weather. They are placed in juxtaposition so that the circular walls surrounding them do not meet at the point of contact of each filter. The walls are of concrete, and the filters are built on the natural soil, except at one place, where it was found that the ground was not sufficiently high to carry the floor. At this point the outside walls were carried down to the proper foundation, and the space between the ground level and the under side of the concrete floor was filled with gravel, the maximum fill being in the vicinity of two feet. The medium is composed of a mixture of broken brick, hard furnace slag, and gravel, the average diameter of the particles being about 2½ to 3 inches. Near the bottom of the filters the slag was put in, in large pieces to protect the four-inch collecting pipes of vitrified and field tile which have ¼-in open joints, and also to permit the quick flow of the liquid along the bottom. The central arm or standard carrying the revolving arms was surrounded by a pigeonholed brick wall, about four feet away from the drum. This construction was not only for the purpose of inspecting the machinery, but also to provide ample aeration for the filter beds themselves. The slope of the floor is six inches in a distance of fifty-four feet. The total medium area of all three filters is .62 acre, the average depth of medium, 7 ft., and the maximum capacity of the sprinklers is one-fifth of maximum, or 133.300 gallons to each distributer.

Humus Tanks.—These tanks, for the purpose of



City of Lethbridge Sewage Disposal Works—Diagrammatic profile.

obtaining further settling of the partially purified liquid after passing through the filters, are constructed in duplicate, and are built adjacent to the filters, and at a depth sufficient to provide a good fall from the central collecting channel of each filter to the distributing channels of the tanks. They have each a capacity of 4,120 cubic feet. The bottom slopes of these tanks are drained to one central sludge valve, and in order to clean out one of these tanks it is necessary to decant the liquid and drain off humus from the bottom with the aid of flushing. These tanks are likewise constructed of concrete and are provided with a roof of concrete reinforced with expanded metal and steel beams in the same manner as the sedimentation tanks. The liquid is drawn off from the tanks into the collecting channel over weirs 12 inches wide, and it then passes into a bafflerace at the upper end of which is inset a pipe leading to the float chamber in the chlorinating house. There is also to be installed a small pipe carrying the hypochlorite solution.

Measurements of each humus tank are as follows:—

(a)	Capacity	4,120 cu. ft.
(b)	Liquid surface area	1,200 sq. ft.
(c)	Length of influent and effluent weirs	80 ft.
(n)	Distance apart of influent and effluent weirs	15 ft.
(e)	Difference in elevation of influent and effluent weirs	.1 ft.

The design of the chlorinating plant is so arranged that there is an automatic regulation of the flow of chlorine solution into the liquid. This is done by the rise and fall of the float in the float chamber, which operates a lever, which in turn regulates the supply. Thus if the volume of liquid coming through the humus tank is increased, the level rises in the bafflerace, causing a consequent increase of chlorine solution to be applied. The bafflerace is only intended to give a thorough mixing of the chlorine solution before the liquid is discharged into the main outfall sewer, which carries the finally purified effluent to the river at a distance of about one thousand feet.

Sludge Beds.—The sludge beds are in duplicate and are simply rectangular excavations in the soil. It was not found necessary when the plant was constructed to do anything towards putting in a gravel or broken stone bottom to these beds, as there are strata of gravel in the excavation which carried away moisture from the deposited sludge in a most effectual manner. This was taken advantage of in the construction of the sludge beds. A narrow roadway at the end of each bed gives access for carts for removing the dried humus. Each bed has a surface area of 480 square feet.

Construction.—The excavation work was started in February, commencing with the sedimentation tank. For this part of the work almost 6,000 cubic yards was removed from the toe of a coulee, the greatest depth being forty-three feet. The surplus dirt was all removed with dump wagons and slips, piled up around the site and afterwards used for banking. After removing the top two or three feet of soil, the excavation was all hard shale, making the work somewhat slow and necessitating blasting, but had the advantage of requiring no shoring or timbering of any description. The concrete was first started by running the footing for the wall and erecting on them sectional forms of dressed boarding. The forms were placed the required distance away from the face of the shale wall and braced from the parallel wall sixteen feet distant, the same bracing thus serving for two walls. The concrete was poured in layers of from two to three feet, a complete circuit being made each day. No reinforcement or joints of any description were introduced, the 18 ft. walls being 3 ft. and 4 ft. thick at the bottom and taperto 18 inches at the top. The 5 ft. walls were a uniform thickness of 18 inches. For a small portion of some of the walls near the top 2 ft. square metal forms were used. These were found easily and quickly handled, left a good face, but were awkward when the length of the wall was not a multiple of the size of the form, or when the intersecting floors were not square with the surface. In laying the hopper floors a runner was laid down each angle, and after laying the concrete side, these were extracted and the spaces were filled in a week or so later. This was found satisfactory where the foundation was hard shale. The floors were 12 inches thick of 1:2:4 concrete laid in one layer, screeded and finished with a steel float. The aggregate used for all concrete was river gravel obtained close to the site; occasionally sand was screened out, but usually the natural gradings with slight adjustment were found to be sufficiently accurate. The 6-inch concrete roof was reinforced with No. 3 mesh 10-gauge expanded metal. The concrete was 1:2:4 laid in one layer, and finished with light tamper and wooden float, the cribbing being partly supported from underneath and partly hung from the 24-inch beams carrying the roof. The fore-slope was composed of a 9-inch concrete base with ¼-inch wire rolled glass 2 feet square laid on the surface, and embedded in a rich mortar of cement; no clips were found necessary. The glass apron was carried on 4-inch I-beams at 8.5 lbs., with 5 ft. centres let into the wall at the upper end and supported on concrete piers 18 inches high at the lower. On the top flange of the beam creosoted wood strips were fixed with small iron cleats sunk flush with the wood. The ¼-inch wired glass in sheets 5 ft. x 3 ft. were laid on these strips, embedded with a mixture of litharge and white lead. Each sheet was secured along the lower edge with two copper clips 3 inches wide secured to the wood. Thus, each sheet was supported entirely independent of the other.

In the building the circular walls of the filters, templates, convex and concave, cut to the proper circle, were placed on top of the foundation, which had been run in trenches. The boxing of placed boards bent horizontally and attached to upright studs was kept in position by the templates at the bottom, and at the top by distance pieces, and securely wired through the thickness of the wall. The boxing was braced from the inside only by means of perpendicular pieces of 2 ins. x 6 ins. placed at a distance of about 7 ft. from the cribbing opposite every second stud and tied into the studding at the top and bottom, and one diagonal brace to each. This method of construction fulfilled the double duty of efficient bracing and also of providing bents for the gangways from which to pour the concrete walls.

The machines mixing the concrete for the filter walls and floors were placed on a staging erected on the same level as the top of the walls. Three mixers were worked, one at the centre of each filter. A gangway ten feet wide and on the same level, and 330 feet long, ran down the centre for the complete length of the three filters, connecting up the three machine stagings, and permitting the teams hauling gravel and sand to enter at one end and drive off at the other. From the mixing stage radial runways were placed out to the edge of the filters, in order that the concrete hand-dump-carts might travel in a circle. The proportions of materials composing the concrete for the floors and walls were the same as for the tanks, the floor being lightly tamped and screeded off. In each filter eight lines of 4-inch vitrified open jointed branch pipes were embedded half their depth in the concrete. These lines ran from the circumference to the centre, and had a fall of 6 inches. The portion of the floor laying between the lines of branches was built with a slight cross fall and drained with 4-inch butt-jointed field pipes.

In placing the medium, the overhead gangway, and especially constructed wagons were used. The medium for filters No. 1 and No. 2 was first broken to the required sizes, selected and shaken free from dust and small particles by means of coke forks, and carefully placed in the wagons. The bottoms of the wagons were of an inverted "V" shape, and projected beyond the sides and over the wheels. The sides were hinged at the top to the two ends, allowing the cart to be dumped on to chutes at each side of the gangway. Each chute terminated on a portable platform from which the medium was taken and spread by means of wheelbarrows. Any medium smashed in dumping was shovelled off the platform back to the gangway. The medium for filter No. 3 consisted entirely of screened gravel, and was carted from the borrow pit directly into the filter.

Operation and Maintenance.—Operation of the plant was commenced in the month of October, 1912, and the apparatus was given a fair trial before heavy frosts set in. Some difficulty was encountered in obtaining a proper seal in the drums of the rotating filters, and it required a considerable length of time to find out the exact cause of the defect. After careful examination it was found that the upper portion of the drum had developed a very small leak which allowed the air gradually to escape, with an ultimate loss of the seal. This was easily repaired and continuous running of the filter units was then possible.

After a month or two, however, it was noticed that a very considerable amount of colloidal matter was accumulating in the revolving arms of the filter, and it was found necessary to employ a man for a large portion of the day to keep the small holes in the filter arms from choking. After several endeavors to find the cause of this trouble it was observed, that when the accumulation in the detritus tank increased the accumulation in the filter arms became more objectionable. Since no adequate means were provided for removing the detritus from the bottom of the tanks, it was decided to flush the accumulating sludge out into one of the sludge beds. This process was then adopted at regular intervals. It appeared, however, that if the detritus tanks were sufficiently shallow to cause practically all the matter which would not pass through the screens to go over into the sedimentation tanks and there be deposited as sludge, the liquid reaching the tanks would be more uniform in consistency, and the process of treatment improved. An alteration of the shape of the chambers was then considered, providing for the filling up of the lower portion of the detritus tanks with stone or gravel, and the building in of a concrete floors, the screens being sloped sufficiently to give the proper area for the capacity of the plant. By doing this it was hoped that the difficulty in connection with the clogging of the filter arms would be obviated, and the nuisance caused by the flushing of the fresh sludge into the sludge beds eliminated. The particular design adopted for the detritus chamber was felt to be the most troublesome feature of the plant.

After the plant had been operating for a month or two, severe frosts were experienced, which caused considerable ice to form on the top of the exposed filter beds, and on one occasion, after a snow fall of some six or eight inches, one of the filters was started up with the expectation that the warm sewage would melt the snow. Unfortunately, however, the weather suddenly became colder, and instead of the snow disappearing, it was changed into ice, and it was found impossible to get rid of this accumulation until it was removed entirely from the filters. This was the only time that there was any trouble with the revolving arms on account of the accumulations, and it should never recur, as the operator has had the benefit of past experience. Throughout the winter months ice appeared on the surface of the filter beds during cold weather, and gradually built up into circular ridges between which were narrow openings, these openings, of course, appearing directly in the line of spray from the filter arms. No attempt was made to measure the efficiency of the beds under such conditions, but it is hoped that a proper laboratory will soon be installed with a chemist in charge, and analyses made of the effluent not only from the filters, but also after passing through all stages of purification. After running the plant throughout the winter months, it was found possible to obtain continuous operation of the filters with their machinery and surfaces exposed to the weather. In the following summer it was established that the fly nuisance was not a serious factor in so isolated a position. The construction of costly roofs over the filter units was therefore abandoned, although provision had been made in the design of the filter machinery for the support of roof trusses from the central posts.

The filters are all thrown into use by the opening of penstocks by hand, which would appear to be a better arrangement than automatic control, for the reason that the winter conditions are sufficiently severe to cause freezing in the drums of filters which might be thrown out of commission for any length of time unless these were drained. Every time a filter is shut down, therefore, the operator proceeds to drain out the drum forming the air seal.

The difference in level between the surface of the liquid in the sedimentation tanks and the top of the riser at the centre of each filter gave considerable trouble when a large volume of sewage was delivered to the plant. There was a noticeable surge in the distributing chamber at the entrance to the filters, and frequently the top of the riser would overflow, thus discharging unfiltered sewage into the humus tanks. It was deemed advisable to make an overflow from the distributing chamber, and this was accomplished by cutting through one of the walls of the chamber and inserting a 12-inch pipe delivering into a trough laid on the top of the filter medium between filters Nos. 1 and 2 at a place not reached by the distributing arms. This arrangement seems to give satisfaction, and once or twice each day there is a surge which is efficiently taken care of in this way.

The design provides for a capacity of two million imperial gallons daily for a population of 20,000 inhabitants using a maximum of 100 gallons per head per day.

The total cost of engineering and construction amounted to $84,000, or $4.20 for each unit of population with the plant operating to capacity.

The design of the undertaking was in the hands of Mr. T. Aird Murray, who acted also in an advisory capacity during the progress of the work. The work was carried out under the direct supervision of Mr. W. A. Adam, Assistant Engineer. Messrs. Hotsen, Leader and Goode successfully executed the work involved in the principal contract.

Recent Developments in Bridge Construction

IN an interesting and comprehensive review of the important engineering work of 1914 our London contemporary, The Surveyor, is particularly illuminating and suggestive in the field of bridge construction. We publish copious extracts relating to general developments in bridge construction and design. The section relating to noteworthy steel bridges of the world will provide information requested of us recently by a number of our readers.

Masonry and concrete are still the most largely used materials for highway bridges, but in many of the highway bridges designed by our railway engineers brick and steel are still in great favor. Brick arches are very useful for short spans and where the depth of material in the bridge is not of great importance; but for spans over 40 ft., masonry, concrete, or steel are more reliable and economical. While masonry or reinforced concrete may be used for spans between 300 ft. and 400 ft., it has not, up to the present, been found advisable to use those materials for greater spans. The longest existing bridge in these materials is the reinforced concrete bridge at Langweis, Switzerland, with a span roughly of 330 ft.; but the proposed Spuyten-Duyvil Creek Bridge at New York, with a span of 703 ft., will eclipse all records in this class of structure. For the largest spans steel is still without a competitor; and while simple trusses can be used up to 700 ft., is is more economical and advisable to adopt the cantilever principle for spans above this length. The cantilever system has generally been adopted for the largest span bridges, such as the Forth Bridge and the new Quebec Bridge over the St. Lawrence River. The site of the bridge cannot always be fixed from purely engineering considerations, as the saving of time and haulage by giving a more direct route may frequently lead to the selection of a more expensive site. Physical considerations again largely influence the design, such as the difficulty of obtaining satisfactory foundations, the avoidance of steep approach roads, the area of the waterway required for floods, and the headway necessary in the case of navigable rivers or canals.

For spans up to 300 ft., which may be said to meet the majority of the cases the municipal engineer has to deal with, there is a growing tendency to prefer reinforced concrete to masonry or steel. The saving in first cost over stone, and the saving in maintenance over steel, accounts for the selection of concrete in most cases; but the flatter arches that can be adopted, and in the case of small spans of the beam and slab type the absence of steep gradients in the bridge approaches, and consequent saving in embankments, make concrete not only convenient and economical, but also a growing and formidable competitor of stone.

Bridge Aesthetics

Stone, however, is still preferred by many engineers, and for nearly all the more important bridges of a national and monumental character stone is the material used for the arches, spandrils and balustrades, though concrete is generally used for backing to arches, spandrils, piers and abutments.

The objection to concrete for facing is its want of color and texture, and the unsightly surface cracks which appear to develop in nearly all concrete structures. Added to this drabness and disfigurement is the fact that neither architects nor engineers have yet solved the problem of treating this material in an artistic or pleasing manner. This is especially so in the case of the majority of bridges where reinforced concrete has been used, for many of them are so bald and ugly that they have brought the materials into great disfavor with many engineers and architects.

NOTEWORTHY STEEL BRIDGES OF THE WORLD

OF very large steel bridges which are still in course of construction or were opened this year, the new Quebec Bridge over the St. Lawrence Rover, the River Ganges Bridge at Sara Ghat, the Scherzer Bridge over the Pamban Channel, between India and Ceylon, and the Manhattan and Hell Gate bridges at New York may be mentioned.

Quebec Bridge.—The new Quebec Bridge now in course of construction is of the cantilever type, and provides for four lines of railway and two footways, but for no highway traffic. It is 3,239 ft. long between the faces of the abutments. The main span is to be 1,800 ft. between the centres of bearing, the anchor arms being 515 ft. long, the cantilever arms 580 ft. long, and the central suspended span will measure 640 ft. It has one approach span 140 ft. long at the south end, and two spans of a total length of 296 ft. at the north end. The width of the bridge is 88 ft., and the clear height above extreme high water is 150 ft. The type of truss is of a somewhat unusual design, being of the so-called "K" system. This type has a number of advantages for a large bridge, especially during construction, the chief being that during erection of the cantilever span it is possible to complete each panel by itself and move the traveller out to the end of the completed portion. The bridge is to take on each track two Cooper's Class E 60 engines, followed or preceded by a train load of 5,000 lb. per lineal foot of track. In addition to the actual dead weight of the structure, a load of 500 lb. per foot run was provided for on the suspended span, and of 800 lb. per foot run on the remainder of the bridge as an allowance for the winter snows. The bridge will weigh 8.7 tons per foot near the centre, and 38 tons per foot near the piers, the corresponding figures for the Forth Bridge being 2 and 13½ tons.

Sara Ghat Bridge.—The bridge over the River Ganges at Sara Ghat, about 120 miles above Calcutta, will carry the main line of the Eastern Bengal State Railway, and ranks as one of the most costly engineering schemes in India and the Far East. The estimated cost of the bridge and approaches is over £3,000,000. It is a double-line bridge, capable of carrying the heaviest future loads, has a headway of 40 ft., and provides a public footway. The river has erodible banks, and at each abutment of the bridge are two guide banks of the Bell-bund type, each 4,000 ft. long. The bridge has fifteen spans of 345 ft., centre to centre of bearings, on piers spaced 359 ft. apart, and at each end there are three spans of 75 ft. The main girders are of the hog-back "N" type, with sub-panels, with a depth of 52 ft. at the centre. The width of the bridge, including the footway, is 48 ft. 6 in. The sixteen main piers are carried on wells sunk to a depth of 150 ft. to 160 ft. below lowest water-level, and are probably the deepest foundations of their kind in the world. It is hoped to complete the work and open the bridge to traffic during the present year.

Pamban Scherzer Bridge.—The Scherzer Bridge over the Pamba Channel, which has been completed this year, affords a means of communication between India and Ceylon. The viaduct from Toniturai Point to Pamban is 6,776 ft. long, and a Scherzer bridge is constructed across the Pamban Channel, the channel being deep enough to allow the passage of vessels of light draught. The viaduct has 145 openings of about 40 ft. span. The opening bridge is a double leaf through Scherzer rolling lift bridge, 225 ft. long and 16 ft. wide. At each end of the bridge is a fixed structure carried on steel cylinders. The leaves are raised and lowered by hand, but provision is made to work them electrically if required. The bridge was opened in February, 1914, and reduces the length of the sea voyage from Colombo to Tuticorin from 150 to 22 miles.

Manhattan Bridge.—The Manhattan Bridge, connecting Manhattan Island and Greater New York, which is described at some length in the Engineer of September 25th and following issues, carries eight lines of railway track, two promenades, and a 35-ft. roadway, and is being completed at a cost of $25,000,000. It is 6,855 ft. long over all, including 2,505 ft. of steel approach viaducts, and is 2,920 ft. long between anchorages. The suspended spans are 725 ft., 1,470 ft., and 725 ft. respectively. They have a maximum clearance of 135 ft. above high-water, and are 120 ft. wide over all. They have four lines of stiffening trusses 24 ft. deep, suspended from cables 21½ in. in diameter and about 223 ft. long, supported on steel towers at a height of 315 ft. above high-water. The eight railway tracks are at two different levels, one being over the other. This bridge has been constructed under several municipal administrations, and the dimensions and type of the structure have been from time to time radically modified. The system was originally designed as a wire cable structure, then changed to one with eyebar cables, and finally restored to the wire-cable system. Several engineers have been successively responsible for the work, and two well-known architects have been responsible for the architectural features of the substructure.

Hell Gate Bridge.—A bridge, which is said to be the largest steel arch bridge in the world, is being constructed at Hell Gate, over the East River in New York, between Long Island and Ward's Island. It will form part of the New York Connecticut Railroad, and carry four lines of railway. It is a two-hinged, framed arch structure of 1,017 ft. span between the towers at each end, 977½ ft. span centre to centre of hinges, and 280 ft. rise from hinges to crown of the lower chord. The roadway will consist of a reinforced-concrete trough, filled with ballast, in which the sleepers will be embedded. The main stringers of the floor carry 8-in. transverse I-beams, 15 in. apart, and between and on the top of these the reinforced concrete slab of the track trough is built. Each track will have its independent trough. Huge towers, built of reinforced concrete and faced with granite, are to be built at each end of the bridge, which not only give the essential stability to the bridge, and form ornamental portals and terminals, but will be used in erecting the structure.

Three other steel railway bridges now being completed, to which brief reference may be made, are the bridges over the Rio Chico, on the Mexican National Railway, the bridge at Riga, and the Great Western Railway bridge at Westbourne Terrace. The Rio Chico Bridge is a single-track cantilever bridge, having anchor arms of 105 ft., cantilever arms of 135 ft., and suspended span of 120 ft., with three-deck girder spans to the approaches, making a total length of 701 ft. 6 in. The Riga Bridge is 700 metres long, and has ten steel arches, the longest span being 90 metres. There is one opening spanned by a 40-metre bascule bridge, operated electrically. The new bridge at Westbourne Terrace has a span of 244 ft.

The Last-Minute Bidder

A rather interesting question came up at a recent road letting, reports Engineering and Contracting. The official advertisement stated that bids would be received until 3 p.m. At the designated hour six bids were in the hands of the official in charge. Two minutes later another contractor submitted his proposal. The bids were opened and it was found that the late bidder had offered to do the work at a price about $100 less than the figures of any of his competitors. The supervisors awarded the contract to the next lowest bidder on the ground that the low bid was submitted after the specified time. It was then claimed that the clock in the room of the official in charge of the letting might be wrong. A telephone inquiry was made at the office of the Western Union Telegraph Company, and it was found that the clock was four minutes fast as compared with the Western Union clock. If the latter time was to be accepted the contractor had submitted his bid two minutes before the closing hour. The supervisors decided, however, that their clock was official time as far as they were concerned and refused to change their decision regarding the award of the work. Last minute bidders might draw a useful moral from the episode.

Announcement is made that the United States Horse Shoe Company, of Erie, Penn., will erect their Canadian factory at Hamilton. The new company will be known as the Canadian Horse Shoe Company, Limited. The firm is capitalized at $300,000, and the new plant will represent an investment of from $125,000 to $150,000. A site of nearly five acres has been purchased at Hamilton, and building operations will be started early this spring. The President and General Manager of the firm is Mr. L. A. McIlroy, of Erie, Penn.

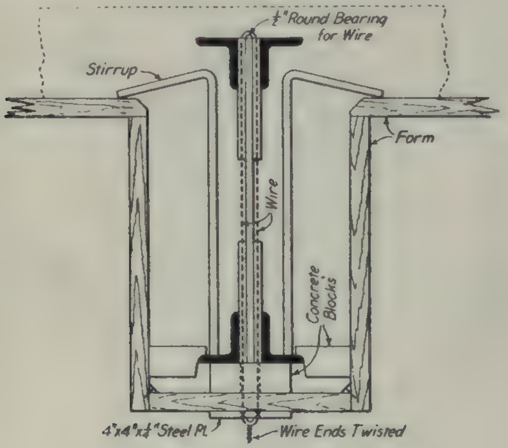
A new prize, the Leonard C. Wason Medal, is to be awarded annually by the American Concrete Institute to the author of the most meritorious paper published by the institute during the year, unless the board of direction decides that none of the papers presented is of such character as to merit the award. The governing conditions are that the competition shall be restricted to members of the institute, and that all original papers presented to the institute by members and published by the institute during the year for which the medal is awarded shall be open to the competition, provided that such papers shall not have been previously contributed in whole or in part to any other association nor printed elsewhere prior to presentation.

Suspended Beam Forms—Their Advantages and Disadvantages

By Sidney Diamant[1]

FROM time to time are proposed concrete beams so designed that in their construction the necessity of wood shoring under the forms is eliminated. To facilitate this the reinforcing steel is made to carry the dead load of the floor system, considering the former as acting alone and independent of its combined effect when bonded with the set concrete. Generally the regular bar reinforcement is replaced by a latticed steel truss of a depth permitting the covering of its top and bottom flanges with 1½-in. thick concrete.

There is an economic depth for the truss to resist the stresses developed only by the dead load or weight of the construction. However, this depth may be somewhat reduced because of the greater value of the truss in the completed reinforced beam to resist stresses developed by the total load. As this type of construction seems advantageous in many cases, especially when long spans have to be built, the writer has made a careful analysis of the design of such beams, their advantages and disadvantages. The following case was assumed: A 10 x 19-in. reinforced-concrete beam, previously calculated, is modified to meet the requirements for the use of suspended forms. The forms are held by wires passing through the space between adjacent chord angles and provided top and bottom with half-round bearing bars, as shown in the accompanying drawing. Previously cast concrete concrete blocks insure the proper relation between truss and form. To release these forms it is necessary only to drive out the lower bearing bar and clip the suspension wires.



Form suspended from beam.

The weight of the 16-in. steel truss, calculated for dead load only and not including impact due to depositing concrete, is 17 per cent. higher than the steel bar reinforcement of the original beam, figured as a constrained member. Because of the distribution of the truss metal, the centre of gravity of the steel is raised considerably, thus decreasing the effective depth of the beam by 40 per cent. Consequently, when the steel in this truss is applied to resist the total moment in the reinforced-concrete beam, it is found to be 35 per cent. too small. The ratio of beam depth to slab thickness develops a width of T-flange of over twice that permissible by New York building code regulations. The maximum deflection of the truss under its full load of wet concrete is ⅜ in. This is scarcely noticeable over the 26-ft. span of the beam, but when impact is considered, this deflection will undoubtedly increase to about 1 in.

Considering this type of construction the following advantages may be claimed: (1) Available clear space below the forms, permitting the finishing of the floor below and providing room for the building of new forms. (2) Cost of timber posts eliminated. (3) No delay in waiting for the concrete to set before removal of posts which are to be used again in the upper construction.

The following disadvantages exist: (1) More steel is required. (2) Excess of steel not again available for use in the upper construction as in the case of wooden shorting. (3) Damage to forms and leaking will result from excessive and varying truss deflection during deposition of concrete. (4) Varying deflection durin normal conditions of erection will prevent constant contact between steel and concrete, thus preventing proper setting of the concrete and bonding of the component parts.—Engineering Record.

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[1] Consulting Engineer, New York.

Concreting in Cold Weather

By Leonard C. Wason[2]

LONG experience can best overcome the obstacles attached to construction work in winter. In laying brick there is danger of the mortar freezing, and in concrete work, danger of the concrete freezing. But while brick walls will generally stand by their own weight, even if the mortar is destroyed by frost, concrete subjected to frost is extremely treacherous. If it is frozen it will be as hard as properly set concrete, but if the forms are removed the work will collapse as soon as a thaw comes. It is true that frozen concrete will, if the forms are kept in place, set properly when the thaw comes, and experiments have shown that the strength may be slightly increased in this way. But only an expert can distinguish between the appearance of frozen concrete and concrete which has set properly.

Our location in New England has made it necessary for us to do a great deal of difficult winter work. From our experience with it, we do not hesitate to recommend the use of reinforced concrete for erection at any time in the year. Each winter we have carried through three or four good sized jobs, and can confidently assert that, in strength and excellence of workmanship, they are fully equal to any summer concrete work. We are willing to undertake and to guarantee concrete work under the most adverse cold weather conditions.

Precaution to be Taken

From the boiler a steam pipe is taken to the sand pile and another one to the stone pile. A canvas should be thrown over the top of the stone pile to retain the heat and keep out storms. On jobs where sand and stone are received on railroad cars a steam pipe laid parallel with the tracks is provided with at frequent intervals, from which hose may be taken directly into the car. This insures that all sand and stone are warm when placed in the mixer. Similarly, steam turned into the water barrel heats the water used in the mixing. The cement is not heated, for this would too greatly accelerate its setting. Salt is frequently mixed with the concrete—from ½ lb. to 2 lbs. to each bag of cement—as a precaution against sudden unexpected drops in temperature. This lowers the freezing point of the water in the concrete, and although it slightly retards the set of the cement, it does not seriously impair its strength.

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[2] President Aberthaw Construction Co., Boston.

Before pouring concrete, all forms are swept clean of snow, and ice is removed with a steam jet. The building as it goes up is enclosed with canvas, floor by floor, until the concrete has fully hardened. Salamanders burning coke are placed underneath all freshly poured concrete and kept burning night and day until the hardening is complete. In this way the inside of the building is kept about 30 deg. F. above that of the air outside. Care is necessary in using salamanders because of the risk of formwork fire—an accident which we have been fortunate in avoiding. The tops of freshly poured concrete floors, which cannot well be enclosed in canvas, are covered with paper and about a foot of hay or straw, the latter sometimes sprinkled with salt. Several other methods are used, as circumstances dictate. Little care need be used to prevent mass concrete from freezing, as the frost will usually strike to a depth of about 1 in. only.

It is very common in winter, because of the danger of freezing, to put the finish on as a separate operation after the building is all enclosed, and not as an integral part of the construction. When it is so put on, it must be kept from frost for the first forty-eight hours at least.

Road Engineer's Tribute

Editor Contract Record:

I have looked over your special issue very carefully and I am much struck with the excellent ideas respecting trade possibilities which have been outlined by your contributors. Numerous suggestions are made which should have much practical value under present conditions and in view of the opportunities for trade development which are now opening up to Canada.

Yours truly,

W. A. McLean,

(Provincial Engineer of Highways for Ontario.)

The expense of protection against the weather is not very great—perhaps from 6 to 10 per cent. more than the cost of the concreting in warm weather. A part of this extra expense is due to the heating operations, a part to the decreased efficiency of workmen numbed by cold, and a smaller part to the comparatively slow progress of work due to allowing a longer period for the concrete to harden. In spite of this, we have found each year several owners who have considered it worth while to pay this extra cost on the score of certain and early delivery of completed buildings the first of the new year.

Occasionally it is necessary to make some provision for the protection of the men. Shelters or wind-shields are built in front of the benches where carpenters are making up forms, as well as around the men at the concrete mixer, whose work does not necessarily keep them warm. Where excavation is going on in the open it pays to have a building with a good fire, where the men can warm themselves when necessary. On a few particularly cold jobs it has proved wise to furnish hot coffee, free, in these shelters.—Concrete-Cement Age.

Proposed Standard Tests of Bituminous Road Materials

THE following is an outline of the proposed standard tests for tar and asphalt recommended by the Committee on Materials for Road Construction and on Standards for their Test and Use, of the American Society of Civil Engineers.

These tests are described in detail in the 1914 progress report of the committee, published in the December Proceedings of the Society, and issued in booklet form by the Secretary.

Tars

Specific gravity at 25 deg. C. (77 deg. F.).
Flash point.
Solubility in CS_2 (carbon disulphide).
Consistency at 4 deg. C. (39 deg. F.), 25 deg. C. (77deg. F.), 46 deg. C. (115 deg. F.), 98 deg. C. (208 deg. F.).
Melting point.
Loss on evaporation at 163 deg. C. (325 deg. F.).
  Consistency of residue at 4 deg. C. (39 deg. F.), 25 deg. C. (77 deg. F.), 46 deg. C. (115 deg. F.), 98 deg. C. (208 deg. F.).
  Melting point of residue.
Distillation.
  Consistency of residue at 4 deg. C. (39 deg. F.), 25 deg. C. (77 deg. F.), 46 deg. C. (115 deg. F.), 98 deg. C. (208 deg. F.).
  Melting point of residue.

Asphaltic Materials

Specific gravity at 25 deg. C. (77 deg. F.).
Flash point.
Colubility in CS_2 (carbon disulphide).
Solubility of bitumen in CCl_4 (carbon tetrachloride).
Solubility of bitumen in petroleum naphtha.
  Character of residue on glass.
Consistency at 4 deg. C. (39 deg. F.), 25 deg. C. (77deg. F.), 46 deg. C. (115 deg. F.), 98 deg. C. (208 deg. F.).
Melting point.
Ductility at 4 deg. C. (39 deg. F.) and 25 deg. C. (77 deg. F.).
Fixed carbon content.
Paraffin content.
Loss on evaporation at 163 deg. C. (325 deg. F.).
  Consistency of residue at 4 deg. C. (39 deg. F.), 25 deg. C. (77 deg. F.), 46 deg. C. (115 deg. F.).
  Melting point of residue.
  Ductility of residue at 4 deg. C. (39 deg. F.) and 25 deg C. (77 deg. F.).

The kind of lumber to use for forms and false work depends upon the character of the work, and to a considerable extent on the available supply in the particular locality in which the work is to be erected. For the support of the form work it is the custom to use as cheap a grade of rough, sound lumber as can be purchased.

The larger cities of the United States appear to be adopting enterprising measures in regard to the resumption of municipal and building work. We note that the city of Philadelphia has already decided upon public improvements to be undertaken during the coming season at a cost of some six million dollars; while in Chicago we hear that in the Loop district five projected new buildings, upon which work is to start at an early date, will cost some four million dollars. Such news is encouraging as indicating that there is capital available for sound investments.

The Street Paving Problems of the Smaller Cities

By Thos. H. MacDonald[*]

No very definite limit has been fixed as to the point at which the large town caterpillar becomes the small city butterfly. Very much depends upon the point of view. No one will seriously question, however, the right of any corporation, no matter how small its population, to call itself a city, if it may point with pride to even a single paved street. Towns may have electric lights, waterworks, and sidewalks by the mile, but paved streets, never. Legislatures may write into the laws of the state the limits of population which determine the legal status of towns and cities; but no law can change a sleepy town into a thriving little city.

Paving promoters are more successful. This conclusion at least must be reached if we believe that the first broad public service that any municipality renders is the building of good streets. All the other first improvements serve the more selfish welfare of the individual and the town. Improved streets serve the best interests of the whole community. Their benefits are neither selfish nor individual. Their usefulness is not limited to those who live within the corporation boundaries, but rather is extended to the whole surrounding territory.

That street improvements should be made by the cities and towns in agricultural communities as rapidly as possible seems only fair, for such improvements provide direct and reciprocal benefits to the agricultural communities upon which so much of the prosperity of these municipalities is dependent.

As indicated by the title, this discussion is limited to small cities. Such a division might easily include the cities of twenty-five to fifty thousand people. Cities of this size have a sufficient support fund to secure competent technical service, and property values are able to withstand paving assessments. There have been volumes written concerning all angles of the paving question, which are applicable to cities of this size.

There are, however, almost innumerable small cities which have serious paving problems, and which have not received due consideration. Because of the large number of these little cities, their aggregate importance to the individual states, and their difficulties in making such improvements, this discussion has been purposely limited to the very small cities.

During the five year period from 1909 to 1913, there were 40 towns in Iowa of less than 15,000 people which built in that time 1,640,000 sq. yds. of pavement of six standard types. The smallest of these towns had only 1,200 people, the largest 14,600, and the average size for the whole number was 4,300 in 1905, increasing to 4,600 in 1910.

It is believed that this average small city is representative of many hundreds all over the United States, but particularly in the Mississippi Valley states, where agricultural conditions are similar. Each little municipality serves a community within a radius of about five miles, and carries on a small manufacturing business. Railroads or electric lines extend the trading radius in certain commodities for perhaps ten or fifteen miles.

Forty such towns for which the correct totals are available have built in five years, the following pavements:

Creosoted wood block	70,300 sq. yds.
Sheet Asphalt	107,700 sq. yds.
Bitulithic	201,700 sq. yds.
Asphaltic concrete	256,500 sq. yds.
Brick	484,600 sq. yds.
Cement concrete	519,000 sq. yds.
Total	1,639,800 sq. yds.

In addition to these types there has been a small yardage of other roadways, which are not recognized as standard pavements.

The problems that these municipalities have to meet in obtaining street improvements are grouped as follows:

Lack of experience with pavements of any character.

Lack of an adequate engineering organization.

Property values and property income are low.

Area incorporated is excessive compared to population.

Plans adopted are imitative of larger cities rather than designed to meet small city requirements.

Contracts have small average yardage.

Lack of any comprehensive improvement plan.

To meet these problems the city which builds its first pavement does not have the advantage of the experience which the larger and older cities have obtained as to the best possible types of pavement to use. There is also a lack of an adequate engineering organization. Although a competent city engineer may be employed, the chances are against his having had any wide experience with various forms of street surfacing, and local laboratory facilities are almost entirely lacking.

Property values, comparatively speaking, are low, and the income from the property does not pay a high per cent. on the investment. The average small city has its corporate boundary lines extending far into the sparsely settled surrounding territory, so that its area in ratio to its population is very large. This is one of the penalties which is always paid when a municipality reaches out for more land to tax. The income is not proportional to the required outlay when adequate improvements are made.

When the city is without experience with pavements of any character the first plans adopted have nearly always been imitative of some of the larger cities. It has not been an uncommon occurrence for committees appointed from the representative citizens, the councils or the commercial clubs of small cities all over the Mississippi Valley to visit Minneapolis, Chicago, St. Louis, or some city of equal importance, in order to study types of pavement adapted to their home city of five to fifteen thousand inhabitants.

Another factor which has been a real difficulty is the average size of contracts which are awarded in the small city. From the data available—which are accurate for the past five years—the following results are secured:

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[*] State Highway Engineer of Iowa.

For the construction of brick and vitrified brick pavements, contracts average as follows:

1909—Six contracts, average of 15,200 sq. yds. each
1910—Seven contracts, average of 13,300 sq. yds. each
1911—Twelve contracts, average of 11,200 sq. yds. each
1912—Three contracts, average of 13,500 sq. yds. each
1913—Ten contracts, average of 11,500 sq. yds. each

In the construction of asphalt pavements this fact has been even more striking. A comparatively expensive plant is required, and contracts have been awarded as follows:

1910—One contract, 10,000 sq.yds.
1912—Two contracts, average of 40,350 sq. yds. each.
1913—One contract, 17,000 sq. yds.

In the construction of creosoted wood block pavements, contracts have averaged as follows:

1909—One contract, 12,470 sq. yds.
1910—Three contracts, average of 16,980 sq. yds. each.
1911—Two contracts, average of 3,530 sq. yds. each.

In the construction of concrete pavements contracts have averaged as follows:

1909—Two contracts, average of 3,500 sq. yds. each
1910—Three contracts, average of 14,200 sq. yds. each
1911—Six contracts, average of 13,000 sq. yds. each
1912—Six contracts, average of 33,350 sq. yds. each
1913—Eleven contracts, average of 17,500 sq. yds. each

In the construction of bitulithic pavements, contracts average as follows:

1909—One contract ... ... 14,000 sq. yds.
1910—Two contracts, average of 56,800 sq. yds. each
1911—One contract ... ... 17,000 sq. yds.
1912—One contract ... ... 6,000 sq. yds.
1913—Two contracts, average of 25,500 sq. yds. each

In the construction of bitulithic pavements a complete plant is required, even for small contracts.

In the construction of asphaltic concrete pavements, contracts average as follows:

1911—One contract ... ... 1,100 sq. yds.
1912—Four contracts, average of 39,000 sq. yds. each
1913—Five contracts, average of 21,600 sq. yds. each

In the construction of asphaltic concrete pavements a complete plant is required, regardless of the size of the contract.

It must be again accented here that this discussion is based entirely upon the actual street improvement record of forty small cities in an agricultural state, and that the facts apply only to conditions of this kind, and not to street improvements in the larger municipalities.

The average size of the contracts, as noted above in detail, it will be admitted, is not sufficient to attract a class of contractors who will devote the best services of their organizations, nor can they supply as complete equipment as is possible on larger contracts.

Another serious problem which the small city necessarily meets is the lack of any comprehensive improvement plan. Frequently the paving program begins with the improvement of a single street, and may not be resumed except in a desultory piecemeal manner. The actual amounts of paving laid do not show any continuity or regularity, but rather a most haphazard plan.

There are in the list of cities from which these records are taken, a few important exceptions. For instance, one contract was let by one city for nearly 100,000 sq. yds. of one type of pavement. In that case a comprehensive plan was adopted, and the results secured satisfactory.

It will be noted that the entire paving program of these forty representative cities was really based on the standard types of pavement that have been developed by large cities, where traffic requirements are heavy, where property values are high, and the incomes from the property much larger. The street improvements of small cities should not be imitative. The difference in traffic requirements, costs, and future development should each be studied in its true relation and true proportions. The type of pavement which makes a beautiful street in some centre of population is not necessarily the proper improvement to place on the average small city thoroughfare. In fact, if street improvements of this character must be carried on in imitation of the larger cities, then the improvement of many streets, which to be useful to the community must have some surfacing, will be long delayed.

Practically every small city has three quite distinctive types of roads. The business streets proper, the residential streets and the main market roads extending into the surrounding farming community, and forming also a part of the net-work of main county and state highways. While these three classes of streets may not demand different types of pavement on account of the traffic requirements, they do require different treatments on account of the financial requirements.

The business street of a small city demands a pavement that can be easily cleaned, that will not be injured by large quantities of mud tracked on the surface, that does not in itself originate dust, and that needs a minimum of repairs. If these requirements be met, the cost is not so important, for property values and property incomes are high enough to justify the cost of any of the standard types of pavement. Taking all these factors into consideration, probably the most economical and satisfactory form of pavement for the business streets of the average small city is cement grouted brick on a concrete base.

The residential streets must be studied very carefully. There are very few small cities which have any extended residential districts to improve, in which the cost is not the first consideration. On the main through roads connecting market centres and towns, reasonably wide pavements must be used, but outside of these a single roadway with wide parkings, or a double line of narrow pavement, with a wide centre parking should be used to reduce the cost. In the districts where rents and property values are highest, some form of bituminous pavement may be used. For the other districts, bricks, concrete or bituminous-coated concrete should be used.

The paving of the main market or country roads through the sparsely built district encountered just within the corporate boundaries of every small city, is usually the most difficult to finance. This has been partly because the improvements have been estimated on the basis of a wide roadway. The actual traffic census over such a road in an average small city showed approximately 900 vehicles of all characters daily. If this is representative, it would be proper to build, beginning with the sparsely settled district, a double track roadway of brick or concrete, and widen the shoulders with gravel or stone, thus treating the street as a main country thoroughfare. In this way such an improvement would not become a financial impossibility.

Specialization and Other Phases of Municipal Engineering Development*

By Norman Scorgie, M. Inst. C. E.[†]

IN our time every branch of engineering has become noticeably more intensive, more complex, but municipal engineering has been peculiarly influenced by the aggregation of people in towns, the occupation of whole towns and even groups of towns in particular trades, the modern conditions of transport, and all the other problems that arise from the endless efforts of man to conform to a social environment which is constantly changing, and, of late, changing so rapidly that it seems to have been revolutionized within the five-and-thirty years since I commenced my career in public service.

In these changes municipal engineering has received less relief from specialization than other branches. Railways and great engineering firms all over the country are introducing more and more specialization, so that for economy of production and administration brains are being classified and organized as much as labor. But the municipal engineer is denied this relief. Admittedly the larger undertakings, mostly classed as municipal trading, are placed in special hands. The borough engineer is no longer called upon to design a town hall in his spare moments, or to manage a tramway system as a hobby; but this is a limitation on the amount of his work, and not on its range. He must still be architect enough to add to the town hall, or adapt an old one to new uses; he may still have to install the tramway system, and will certainly be called on for inspiration in any difficulties that arise in its working; he may not have to manufacture gas or electricity, but he has to possess a knowledge of their manufacture and the actual cost of production before he can persuade the gas or electrical engineer to sell them at a fair price for public lighting; he must be something of a bacteriologist to deal with sewage; and more than a little of a lawyer in order to pick holes in the opinions of eminent counsel in matters of public health law; and, finally, in the present year he must be an expert in designing shaded color schemes for London, and in digging trenches to defeat German howitzers.

Specialization in Municipal Engineering

The reasons why municipal engineering has not been specialized are fairly obvious. (I am using this term throughout as a convenient one for civil engineering under local authorities, although they may not be municipalities). To some extent it may be that a council of voluntary laymen compares unfavorably with a board of paid directors in dealing with administrative reform. It has not the stimulus of trade competition to induce it to take the best advice and the most elaborate pains to effect economies and improvements; and, on the other hand, it has to fear an electorate which, in some instances, is apt to assume that high salaries are necessarily wasteful, and that cheap labor is good labor. But if all this be admitted, it is not a sufficient reason, because the influence of lay control of engineering, whether by public authority or by private directors, is necessarily becoming less as the work of the engineer becomes more technical. The eighteenth century saw the end of the period when a well-educated man might hope for a working knowledge of all professional lore in current use—although, unfortunately, the twentieth century still produces laymen who think they have that knowledge.

The real reason for the difference in this connection between municipal and other engineering seems to me to depend on the nature of the work itself, and the conditions of local government in this country. In commercial engineering a large output is clearly one of the conditions for success, and the impulse to specialize in one particular line can be encouraged, and it is encouraged by studying local resources to such an extent that whole districts are devoted to the manufacture of one particular article; which, as I have already suggested, only increases the difficulties of the unfortunate municipal engineer, who must know the process as thoroughly as the manufacturer himself, in order to make proper sanitary provision for waste products and other special conditions brought about by the trade. Where engineering firms still continue a wide range of output, or where they enter upon new work, such as the armament firms taking up motorcar manufacture, the work is specialized, with separate factories, separately controlled. They may advertise that their motor cars are "built like a Dreadnought," but I venture to question whether the chief naval designer had much to do with them. In the motor-car trade itself, as an example, the tendency is in the direction of specialization in one design, or, at any rate, a very limited range of models, for each firm. We may deplore this from an uneasy feeling that it will have a paralyzing effect on initiative; and we may sincerely hope that it will never attain such dimensions in England as it has in America, so that very obvious errors of design cannot be altered because of the expense of altering machinery dealing with such enormous outputs as one complete motor car every forty seconds. But we must recognize that this tendency is winning on its merits, and endeavor to meet such evils as it brings in its train by striving to improve the status of the engineer so that the designer may have the controlling voice in the factory.

Similarly in railway engineering specialization increases, although the conditions are different. Railways cannot limit themselves to the carriage of one class of goods, or the design of one type of locomotive, but they can substitute, and are rapidly substituting, delegation for decentralization. The engineer for the A district and the engineer for the B district are giving place to engineers for this particular work and for that, each over the whole system—such as one for the track only, another for signals and telegraphs, a third for bridges and tunnels.

But local government by small areas makes anything of this sort impossible in municipal engineering. The town council cannot specialize in house refuse, and refuse to scavenge or light and streets, and, on the other hand, it cannot afford, since its area is small, to pay adequate salaries to a number of separate experts. Therefore, the municipal engineer is bound to be something of a jack-of-all-trades (although not, I hope, master of none). He must know something of everything and everything of something, be an opportunist, doing his best with the material ready to his hand, hampered on every side by limitations and vested interests. His plant is largely classed as unproductive. His results are increased public convenience and reduced death-rate. They are often very striking, but they are not directly measurable in pounds, shillings and pence; or rather payment is not made directly in those terms to his employers. If a railway engineer can satisfy his directors that a proposed widening will increase earnings, or decrease working expenses by a sufficient amount, they will let him proceed, and if his estimate is sound the board will recoup their outlay and satisfy the shareholders. By elaborate traffic censuses the municipal engineer may prove that a certain road or bridge widening would repay its cost to the public at the very lowest estimate of the loss caused by the present congestion, but (in default of a toll) he cannot produce the money to the town council, or they to the ratepayers.

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* Extracts from Presidental Address delivered recently in London before the Society of Engineers.

[†] Borough Engineer of Hackney.

Municipal Expenditure

Public expenditure, both national and local, is constantly increasing, and one can see no sign of any check. (I am speaking of the normal conditions before the war). Old-fashioned ideas of economy have broken down. The public is in revolt against the belief that the spending of money is always an evil to be avoided if possible. There is grave danger that for want of guidance they may incline—indeed they have inclined—to the opposite fallacy that all spending of money as long as it is on public objects is a good thing to be encouraged as much as possible. Ignorant or interested opposition to all municipal enterprise was able to conceal from the public for many years the fact that the value or productiveness of work for the community at large cannot properly be measured in the only term known to private enterprise—a monetary dividend. Now that they have awakened to that truth, and the opposition of the company-promoting financier is discredited, it is naturally difficult to get them to distinguish between the financier and the economist, or to realize that municipal work is just as much subject to economic principles as any other form of expenditure. I venture to suggest that every young engineer starting in municipal practice should consider a grounding in the science of economics an important part of his professional training, so that he may be able to advise his council on the economic aspects of any proposal that comes before him, and they may pass on the information to their constituents. Whether it is a new open space, or a housing scheme for a slum area, a new system of scavenging, or a new tramway line, or anything involving expenditure within the province of the municipal engineer, it should be possible for him to arrive at the actual gain to the community in terms of money, after making proper deductions for benefits outside the area of taxation, with a reasonable margin of error, varying according to the information at his disposal, and likely to become less and less if the estimate were properly made in all cases, and statistics accumulated. If his calculations are correct this return on the capital, good or poor as the case may be, is a perfectly definite thing, although the expenditure may be unproductive in the financial sense. Ten shillings a year saved in the doctor's bill for each household is as tangible as a ten-shilling reduction in the rate demand note.

I am not posing as an advocate for or against municipal trading, but I am suggesting that the misleading division of municipal expenditure into productive and unproductive is one which the municipal engineer should combat, and in its place he should strive to set up an enlightened public opinion as to the real aims and productiveness of his work. It is public ignorance of the difference in the material results to be expected from it and other forms of engineering which condemns him, on the one hand, to the use of obsolete devices in the interests of so-called economy, and, on the other hand, to embark on unsound schemes for the sake of an immediate profit or saving.

Status

I have said already that our work, extraordinarily interesting as it sometimes is in its variety, is not work in which one has either the leisure or the inclination for abstract speculation, and I am not going to depart from my own rule except to consider briefly whether the present wide scope of municipal engineering is likely to be a permanent condition.

In recent years it has probably been of some advantage to the profession as a whole that one branch of it should have remained exempt from the increase of specialization, because specialization always produces a temporary decline in status. We are apt to value a thing by the price it will fetch, and a man by the salary or fees he can command, and if the work of an engineering post formerly held by one man is split up among several, it is clear that the individual salaries will be smaller and the status of the holder to some extent less than that of their predecessor. It is only a temporary depression, for two reasons: First, if the change is a good one it will lead to such an increase of business that the separate appointments will eventually be worth more than the original one; secondly, and more important, in the case of these firms and public authrities whose work is largely concerned with engineering, the importance of engineering knowledge in high places is becoming more and more recognized, so that, while the purely professional work of a chief engineer may be abolished by the division of it among independent departmental engineers, yet the appointment of an engineer as chief executive officer is becoming usual. The title "engineer and manager" or "engineer and secretary" is now common; even large railway companies have begun to follow foreign example and appoint an engineer as general manager, and under many public authorities (which it would be invidious to mention) the engineer enjoys that most extraordinary proof of status—a higher salary—although the clerk is, by surviving custom or Act of Parliament, the first official.

In any event I do not suggest that this service of unity in a period of temporary disunion, which municipal engineering has done to the profession as a whole, is a permanently valuable one, because I am not among those who think that the status of engineering is permanently at the mercy of anything except the merit of the engineer. One simple safeguard we should have, such as every profession has found necessary for its protection against charlatans—namely, that no one who is not properly qualified should be allowed to call himself an engineer. Beyond that I think we could work out our salvation without the aid of many shibboleths. It may be argued that those professions which by common consent enjoy the highest prestige, such as medicine and law, are protected by elaborate codes of etiquette and internal discipline; but it should be remembered that those codes are late products in professional history. Whatever we may think of their value, they are the devices of a professional class to preserve a position which it has already won on its merits and without their assistance. The lawyer class became influential in England as soon as the legal system developed, because of their superior knowledge of it, and their right of exclusive audience in the courts was the result and not the cause of their influence. And in medicine it is probable that nowadays the surgeon enjoys a slight professional and social precedence over the physician; yet the surgeon is a comparatively newcomer to the medical profession—the common barber promoted. He owes his promotion solely to the merits and exactness of modern surgery. The moral of this on engineering status is important enough to be worth emphasizing. It should encourage us to do everything in our power to set a high standard of professional service, and, as the retiring president pointed out in his address last year, of independent service. The value of the doctor's prescription over the patent medicine is partly its independence of trade interest. The barrister has maintained his right of audience when other monopolies have broken down because his services, at his usual fees, are at the disposal of all; he may not refuse a brief or claim a special fee because he does not like a case or a client. These analogies should also save us from depression when we do not see those results which we should like from the activities of this and other engineering societies within the limits of a few years. The village inn-keeper as surveyor of highways some years ago, or even the village cycle-repairer blossoming into the motor engineer of to-day, may seem a low ancestry; but the barber and apothecary were at least as low.

The Decay of Wood Pipe

THE length of life of wood pipe is dependent on the life of the wood staves rather than on the life of the bands, although contrary theories were held thirty years ago, according to Bulletin 155 of the U. S. Department of Agriculture, from which these notes are taken. Only in rare instances have the bands failed first. Corrosion of the bands, being a chemical action, requires the presence of moisture and oxygen. It usually occurs most rapidly where pipes are buried and the backfill is wet under conditions which, as a rule, are most favorable for the life of the wood. Corrosion is greatly accelerated by the presence of alkali in the soil.

The decay of wood pipe is due primarily to the growth of fungi, though possibly certain forms of bacteria may assist in the final destruction of the wood cells. The growth of fungi to an extent detrimental to the life of the wood requires a favorable combination of moisture, air and heat. The exclusion of any one of these beyond certain limits prevents their growth.

It follows that with pipes buried in the ground the wood will endure longest where the air is most nearly excluded, either by a high internal pressure which completely saturates it, or by a deep covering of very fine soil. In accordance with the foregoing statement experience shows that in contact with the soil, wood pipe decays more rapidly under a light head than it does under heavy pressure, and other things being equal, it usually decays more rapidly in a porous open soil, such as sand or gravel, than in a fine soil of silt or clay, because the finer soil is more effective in excluding the air. Experience appears to indicate also that wood decays more rapidly in a loamy soil, rich in humus or partly decayed organic matter, than it does in one containing little or no humus. This is probably due to the fact that the presence of organic matter affords more favorable conditions for the development of fungus growths and bacteria.

Pipes fully exposed to the atmosphere and free from contact with the soil will, as a rule, be too dry on the exterior to favor the development of fungus spores, and so long as the outside of a pipe remains dry no appreciable decay will occur, even though the internal pressure is very light. Decay of exposed pipes almost invariably starts at the ends of staves, as a result of leaky joints. Where water leaks out and runs down over the outside of the pipe favorable conditions are afforded for the growth of algae; then mosses may begin to grow in the soil that collects on such spots, and decay spreads to adjoining staves. Bruising the staves in handling or injuring them by too tight cinching fo bands renders them more susceptible to infection by the spores of wood-destroying fungi, thus hastening decay. The life of exposed pipes may be prolonged by promptly stopping all leaks as they develop and by keeping the exteriors dry. The decay of buried pipes has also in some instances been arrested by removing the covering and leaving them exposed.

The asphaltum or tar coating applied to machine-banded pipe, while intended primarily as a protection against corrosion of the bands, doubtless helps also to some extent in preserving the wood. Until recently the practice has been to leave the ends of wooden sleeve couplings untreated. These couplings almost invariably decay long before the main pipe. This may indicate that infection by wood-destroying organisms starts principally where the coating is absent, though less perfect saturation of the wood in the sleeves may be the more largely responsible for the early decay, as it may also be noted that decay occurs at summits of pipe lines, where air accumulates, much sooner than at depressions.

The practice of coating continuous stave pipe has not been common, but in a considerable number of cases some treatment has been applied for the purpose of preserving the wood. There is wide difference of opinion as to the value of such treatment, and the effectiveness for the purpose intended may also depend greatly on what is used and on how and when it is applied.

On exposed portions of new pipes the U. S. Reclamation Service has used a paint consisting of 6 lbs. of red oxide mixed with 1 gal. of boiled linseed oil. One gallon of the paint was sufficient for two coats on 125 sq. ft. of pipe. On the top of the pipe, where it is exposed to the sun and where water from leaky joints runs down over it, this paint does not last long, much of it being gone in two years. Repainting while the pipe is in use is usually not practicable, because oil paint will not adhere readily to wet material. The use of paint on exposed pipes under ordinary conditions probably adds very little to their life.

A diver's suit for work down to a depth of 300 ft. was exhibited at the second International Exposition for Safety and Sanitation held at the Grand Central Palace, New York City. The suit is made entirely of metal and the diver works under a pressure slightly above the atmospheric pressure. The suit has been tested at the shops for a hydrostatic pressure corresponding to a depth of more than 300 ft. and last July a diver descended in such a suit 212 ft. below the water surface of Long Island Sound.

Painting Structural Steel

Good and Bad Practice in the Application of Shop and Field Coats

THE following recommendations are abstracted from a report of the Committee on Iron and Steel Structures at a recent meeting of the American Railway Association:

Scientific research and numerous practical tests have demonstrated the fact that certain paint pigments, though possessing excellent moisture-repelling properties, will actually stimulate corrosion when applied directly to steel surfaces, while certain other pigments have a tendency to restrict and repress corrosion when used for primers and foundation coats. Because of this, we divide the pigments into rust retarding, and air and moisture excluding groups, using the first for priming and contact coats, and the latter for finishing and exposed outer surfaces.

A rust retarding coat may be suitably compounded from red lead mixed with pure linseed oil. The average stock mixture may consist of from 25 to 30 pounds of red lead to the gallon of oil. This mixture can then be reduced to the proper consistency at the time of application. A small amount of turpentine added to this brush coating will greatly help in its manipulation and will also provide for proper penetration. Red lead should always be mixed at the time of its application, for it settles quite readily, as it is an extremely heavy pigment.

Natural oxides have also grown to be very good for priming purposes, and very satisfactory results are recorded from their use. A number of consumers favor oxides because of their easier application and the less expert class of labor which is required to apply them. A saving of from 5 to 10 per cent., as compared with red lead paint, can thus be effected. Some concerns are using a combination of red lead and oxide and make good reports regarding it.

It appears to be a universal opinion that linseed oil is not a desirable material for the prime coating of metals when used without the addition of pigments. A foundation coat of linseed oil is very often the direct cause of peeling and blistering of the other several coatings applied over it.

Paints containing the same kinds of pigments as for shop coatings, can be successfully used for the first field coat, providing it is covered with another elastic outer coating. If that is not done, paints suitable for finishing coats should be applied, and the first field coat omitted. Red lead or oxide priming should be darkened for this coat by adding carbon or lampblack in the proportion of 90 to 95 per cent. of the reds and 5 to 10 per cent. of carbon mixed.

Carbon, lampblack and graphite pigments, singly or mixtures of them, have given best satisfaction as outer surface and finishing paints. These, combined with some inert and reinforcing pigments according to special formulas, form the basis for nearly every satisfactory brand of metal paint on the market. The addition of some high-grade gum like Kauri improves a finishing paint greatly, producing more elasticity, resistance and life. It is, of course, just as essential that the oils entering into the makeup and composition of the various paints are of the proper kind and quality, as that the selection and composition of pigments be properly made.

Paints containing tar, or those with a tar base, should not be used on steel structures exposed to the sun and weather, as tar-paint films rapidly check, crack and "alligator."

When for any reason it becomes necessary to repaint an iron or steel structure, the paint should never be applied in wet or freezing weather, and the surface should be freed absolutely from all scale, rust, dirt, etc. When for some reason it is not possible that the entire structure can receive a coat of some rust-retarding primer, the parts cleaned and freed from rust, and all exposed surfaces, at least, should be touched up with either a red lead or oxide primer, before the finishing coat is given. The use of turpentine in the paint applied over the old surface is advised, as turpentine is a penetrant, provides the penetration and adhesion between the old paint film and the new coat.

Although more expensive, cleaning by sand blast is much more thorough than the hammer, chisel, scraper and wire brush method, and the greater cost is readily offset by better results in the end. The sand blast method thus far has not been very extensively used. Where the sand blast has been used and the steel has been painted promptly, it has not shown signs of corrosion again nearly as quickly as steel cleaned by hand.

Occasionally we notice defects showing up here and there on a steel structure within an unusually short time after the completion of the painting. We decide to visit the mill, and there we may notice in a remote part of the place a bunch of unskilled laborers mopping paint on some steel that had been sent along for priming, using large 6-inch or 8-inch flat brushes, and covering over all mill scale, rust, dirt and other imperfections, each and every one a destructive agent to the life of steel.

Next we pay attention to the paint they are using and learn that the package, which was opened some time ago to be inspected and was left standing uncovered all this time, had contained the standard paint as specified, but now, through neglect is no longer fit for its purpose. On examining the contents of the package closely, we also notice that the paint is scarcely stirred up, and we see that the oily substance from the top of the mixture is first used, and as the work progresses and the material is consumed, the paint becomes heavier and intermixed with more or less pigment, until when the lower part of the package is reached nothing is left but a semi-dry pigment, which will no longer spread under the brush. Now, to assist in brushing, the men reach for the benzine can and reduce the paint with it, destroying what little life the paint had first contained. In this way a number of different surfaces and films are created on the same structure, and from the same package of the so-called protective coating.

The foregoing illustration may appear somewhat severely drawn, and the situation presented greatly exaggerated; nevertheless, if a number of troublesome cases were thoroughly sifted, the illustration, in part, or in whole, would be identical with the underlying causes of the trouble.

No matter how diligent and untiring an inspector may be, it is not possible for him to be in a number of places at the same time, for, in large plants, where modern methods are pursued in the manufacture and assembling of steel, the various departments are sometimes miles apart.

Of course, not all failures are due to work which was first painted at plants, for often, even among so-called intelligent mechanics, the belief still exists that anything in the way of paint is good enough for priming purposes, so long as it is going to be covered again with paint, thus entirely ignoring the fundamental principles of a correct foundation.

It may, therefore, be suggested that considerable attention be given to the education and maintenance of steel structures, so that greater interest in the problem will be aroused, better co-operation between the various departments effected, and the proper men chosen to handle the different lines of work.

Preliminary Report on the Edison Fire

THE special committee appointed by the American Concrete Institute to report upon the fire at the Edison plant, after careful investigation of the character of the buildings and their contents, the origin and intensity of the fire, and the behaviour of the various materials of construction in the fire, has reached the following preliminary findings:

1. No building or any portion thereof can be considered absolutely fireproof. The resistance of buildings and building materials to fire is only relative; no material can resist a fire if it be of sufficient great intensity or duration.

2. The information obtained confirms the general principles already well established concerning protection against the origin and spread of fire.

3. The buildings of this plant were not in accord with present well-established practice in that they deviated from this practice in the following particulars:

(a) Large undivided floor areas. (Lack of fire walls and stops).

(b) Unprotected exterior openings. (Wooden sash with plain glass, etc.

(c) Absence of proper fire walls, partitions and fire doors.

(d) Failure to inclose properly vertical openings, stairway and elevator shafts.

(e) Absence of adequate sprinkler equipment.

(f) Absence of adequate water supply and fire fighting apparatus.

(g) Failure to either isolate non-fireproof buildings or to protect against them.

(h) Failure to isolate hazardous processes of manufacture either by placing such processes in separate buildings or surrounding them by proper fire walls.

4. The fire fully demonstrated the advantages of monolithic structures. The fact that at five different places several of the wall columns were rendered useless, and yet the upper portions of the building stood intact, is evidence of the superior merits of concrete in monolithic construction.

5. Considering the extraordinary conditions surrounding this fire, the behaviour of the concrete buildings was highly satisfactory and constitutes an excellent demonstration of the merits of concrete as a fire-resisting building material. It is not so surprising that the concrete buildings were damaged as that any material should have so satisfactorily withstood these unusual conditions.

6. This fire brought out the following important problems which are considered worthy of further investigation:

(a) The strength of the structure after the fire; to be determined by floor load tests.

(b) The extent to which the floor system has been strengthened by the method of reconstruction.

(c) The strength of the columns after the fire; the strength of the restored columns.

(d) The effect of expansion, from temperature changes, on large units.

(e) Such other effects of this fire on the structures and structural materials as the conditions may permit.

7. Your Committee is of the opinion:

(a) That the best type of construction is one which eliminates corners and presents flat or rounded surfaces to the action of the fire. That interior columns of circular or octagonal section offer greater resistance to fire and are less liable to damage than columns of square section, and that the elimination of sharp corners in the floor construction is desirable.

(b) That good construction requires a sufficient number of lateral ties or hooping in the columns, and that such construction would offer greater resistance to fire.

(c) That in the beam-and-girder type of construction in order to develop fully T action the slab should be cast at the same time that the beams and girders are poured, and there should be adequate ties between the reinforcement of the beams and girders and that of the slab.

Mainly Constructional

East and West—From Coast to Coast

EASTERN CANADA

Plans have been prepared for an exhibition building at Woodstock, N.B.

The matter of a new fire hall for Niagara Falls, Ont., is being investigated.

The City of Stratford, Ont., propose to construct a trunk sewer to cost $72,000.

The Ottawa Electric Railway Company will extend their system along Bronson Street.

The Canadian Consolidated Rubber Company, Berlin, Ont., contemplate an addition to their factory.

The Mackenzie-Mann interests, it is said, are contemplating building another bridge over the Niagara River.

The "Leger" Hotel, Bathurst, N.B., destroyed by fire recently at a loss of $20,000, will be rebuilt in the spring.

Plans for the remodelling of the Sarnia Town Hall have been adopted and tenders for the work will shortly be called.

Work will be started in the spring on the construction of a breakwater at London, Ont. The estimated cost is $25,000.

Work will be started by day labor in the laying of sewers and water mains, to cost $25,000, for the city of St. John, N.B.

An architect has been called to inspect the Teeswater Town Hall and give an estimate of the cost of the repairs necessary.

The Protestant Board of School Commissioners, Sherbrooke, Que., will call for tenders for the erection of a new high school shortly.

The Arcadia Collegiate Academy contemplate an extension to the girls' residence at Wolfville, N.S. The estimated cost is $10,000.

The planing mill owned by Messrs. Anglin & Company, Kingston, Ont., destroyed by fire recently will be rebuilt as soon as the insurance is adjusted.

The Canada Machinery Corporation, Limited, will concentrate the whole of their business in Galt, Ont., and extensions to their plant there are under consideration.

The estimates for the current year, amounting to $78,246, of the Toronto City Architect have been approved. These are $4,000 in excess of last year's estimates.

The new collegiate high school, for which the City of Toronto intend to raise the sum of $250,000, will be one of the most up-to-date collegiate institutes in Canada.

About twenty-one miles of Brantford's (Ont.) streets will be oiled this year. The cost of oiling the streets, labor included, is estimated at $1,500 more than that of street watering.

Drainage work to the value of $27,200 will be started for the township of Kenyon, Ont., as soon as weather permits. The engineers for the work are Messrs. Magwood & Stidwell, Cornwall, Ont.

Fire at Sault Ste. Marie, Ont., destroyed a business block owned by T. D. Barnes of that city. The loss, which is covered by insurance, was $100,000. It is stated that a new building will probably be erected.

A clause inserted by the Lower House at Quebec, exempting from municipal taxation the property of the Canadian Society of Civil Engineers, was struck out by the Private Bills Committee of the Legislative Council.

At a meeting held recently in Smith's Falls, Ont., a committee selected from the delegates representing seventeen municipalities was appointed to investigate the report on the question of Hydro-Electric Power and Radial Railways.

An order has been received by the city of Peterborough from the Provincial Board of Health authorizing the construction of an outfall sewer as outlined by the city engineer. A pumping station will be required, and a force main is a part of the scheme.

The finishing touches are being put on the Queen Mary Road School which is being erected at Montreal by the School Commissioners of Notre Dame de Grace. The building is four storeys high, 126 ft. x 64 ft. in dimensions, of steel and concrete construction.

Excavation is about to be commenced for the new "Bancroft" school at Montreal, for which plans have been prepared by Messrs. Nobbs & Hyde. The estimated cost of the new building is $200,000. Messrs. A. F. Byers & Company are the general contractors.

The Grand Trunk Railway Company has decided to build a new wharf for the Northern Navigation Company at Sarnia. It is estimated that the work, which will be done by the employees of the G. T. R., will cost about $20,000, and that it will take about two months to complete.

Canada is to have an aeroplane factory and instruction school in aviation. The Curtiss Aeroplanes & Motors Company, Limited, has been incorporated with a capital stock of $50,000, with head office at Toronto. The company is a branch of the Curtiss Bros. Aeroplane Company in the United States.

Hydraulic power construction involving the expenditure of three million dollars is contemplated at Niagara Falls, Ont., by the Canadian Niagara Power Company. The work will include a large concrete dam and the installation of turbines and generators. Operations will not be started for some time.

The new business building erected at Montreal by Messrs. Norcross Bros. for the National Trust Company, according to plans prepared by Mr. Kenneth G. Rea, is nearing completion. The building is three storeys high, of stone, brick and granite construction. The cost is in the neighborhood of $150,000.

Application will be made to the Legislature of the Province of Ontario, on behalf of the town of Gananoque, for authority to issue debentures for the sum of $12,000. Of this amount $7,000 is to defray expenses incurred for the purpose of good roads over and above the sum authorized by by-laws of the Counties Council.

The City Architect's Department, Toronto, have issued a building permit to Mr. R. C. Bustard for the erection of a six-storey terra-cotta office building, costing $29,000, on Yonge Street. Mr. Bustard will also build a pair of 3-storey brick stores and apartment houses, costing $7,500 on St. Clair Avenue, also a block of five stores and apartments costing $13,000, on the south-east corner of Lauder and St. Clair Avenues.

The Montreal City Council have voted a sum of $800,000—in round figures—for the construction of sewers on various streets this season. The work will probably be done by day labor. Tenders for sewer brick will be called as required.

In a recent report submitted by the City Engineer of Peterborough, Ont., on the question of paving, it was recommended that a section of some street be selected where the traffic is uniform and conditions as to foundations, etc., are as nearly alike as possible, and trial sections of several types of pavement of not less than 750 sq. yds. area be laid down.

The contract for the construction of 2,000 feet of breakwater on the Mission River, Fort William, has been awarded to the Thunder Bay Contracting Company, and the work will be commenced as soon as navigation opens. The cost of the work will be about a quarter million dollars, and forms part of the $1,200,000 of the estimates for harbor improvements at the head of the lakes this year.

WESTERN CANADA

A market will be erected on 11th Avenue, Regina, by Mr. L. B. Doughan.

Plans for the new drill hall and armoury at Calgary, Alta., are about completed.

According to the Hon. Chas. Stewart, Minister of Public Works, Alta., $500,000 is available for work on the trunk roads in the province this year.

The fire which occurred recently in the business district of Snohomish, B.C., has caused damage to the extent of $50,000. Several buildings were destroyed.

The Peace River Dredging Company (Peace River Crossing, Alta.) has been incorporated with a capital of $100,000 for the purpose of dredging the Peace River.

At Calgary, Alta., the civic construction department have made a start on the extension of the electric light system, which is being undertaken at a cost of $300,000.

The opening ceremony in connection with the traffic bridge over the Pitt River, B.C., will take place early in April. Only one more span remains to be placed, and in a few weeks the structure will be completed.

Messrs. Campbell & Whipple have secured the contract for remodelling the main building and installing an operating room in the Vancouver General Hospital. The work, which will start immediately, will cost approximately $75,000.

The Bassano & Bow Railroad Company will apply to Legislature for authority to construct a line to Coronation, Alta. The solicitors for the applicants are Short, Woods, Biggar & Collisson, 14 Howard Avenue, Edmonton, Alta.

The Dominion Government armoury at Prince Albert, Sask., now nearing completion, is costing some $250,000. The building is one storey high, 143 x 241 ft. in dimensions, of stone, brick and concrete construction. The general contractors are Messrs. Piggott & Healy, North Battleford.

Plans for a viaduct over the C. P. R. tracks at 5th street, Medicine Hat have been approved and will shortly be presented to the Board of Railway Commissioners for approval. The cost of the work will be in the neighborhood of $181,000, of which some $22,000 is for paving the bridge and approaches.

The Smoky Valley & Peace River Railroad Company will apply to the Legislature for incorporation and power to construct a line from the junction of Solomon Creek with the Athabasca River, to connect with the C. N. W. at Dunvegan. The solicitors are Short, Woods, Biggar & Collisson, Edmonton, Alta.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Beverley, Alta.
The town council will raise $75,000 for the installation of waterworks, sewerage scheme and electric lighting. Engineer, Mr. H. E. Read, Beverley.

Bosanquet Township, Ont.
The Township Council are about to lay cement sidewalks on Grand Bend, and to repair several drains. Clerk, George Sutherland, Thedford.

Calgary, Alta.
The City Council have suspended work on extension of waterworks system. Work will be recommenced in spring. Estimated expenditure, $80,000.

Chatham, Ont.
The reservoir which the Town Council had in contemplation will not be built at present.

Cornwall Township, Ont.
A contract for laying drain will be let in spring, by the Township Council. Estimated expenditure, $9,000. Engineers, Magwood & Stidwell, Cornwall. Clerk, John Mullin, Mille Roches.

Edmonton, Alta.
City Council is about to construct sewer to stock yards. Estimated cost, $19,000. Engineer, A. J. Latornell. Superintendent of stock yards, E. B. Edwards, 113 Jarvis Avenue E.

In connection with contemplated sewer, the address of Mr. E. B. Edwards, Superintendent of Stock Yards, is 113 Jasper Avenue E., not as published in our last issue.

Finch Township, Ont.
The Township Council contemplate laying drain. Contract will be let about June 1st. Estimated cost, $5,000. Engineers, Magwood & Stidwell, Cornwall. Clerk, D. B. Cameron, Berwick.

Kenyon Township, Ont.
It is proposed to start work on drain as soon as weather permits. Estimated expenditure, $27,200. Engineers, Magwood & Stidwell. Clerk, J. D. Cameron, Greenfield.

Lochiel Township, Ont.
A contract will be let in May for laying drain for Township Council. Estimated cost, $4,800. Engineers, Magwood & Stidwell, Cornwall. Clerk, V. G. Chisholm, Alexandria.

London, Ont.
The City Engineer, Mr. H. A. Brazier, is preparing estimates for paving Rideau Street, from Ferguson Place to city limits.

Middlesex County, Ont.
The county council have decided to borrow $96,000 for improvements to roads and for reconstructing bridges. Mr. T. E. Robson, London, is clerk to the council.

Moncton, N.B.
The City Council propose to raise $11,081 for construction of sewers, and $15,000 for construction of sidewalks. Clerk, J. S. Magee.

New Westminster, B.C
The City Council have approved recommendation from Board of Works, that 6th Street, from Columbia to 3rd Avenue, and Carnarvon Street, from 8th Street to bridge, be macadamized. Engineer, T. W. B. Blackman.

Oak Bay, B.C.
A by-law to raise $30,000 for construction of surface drainage system, has been passed by ratepayers. Clerk to Municipal Council, F. W. Clayton.

Osgoode Township, Ont.
The Township Council are considering laying drain, to cost $9,300. Contract to be let in summer. Engineers, Magwood & Stidwell, Cornwall. Clerk, F. Iveson, Metcalfe.

Osnabruck Township, Ont.
The Township Council are considering construction of drain, estimated to cost $3,500. Contract will be let about June 1st. Engineers, Magwood & Stidwell, Cornwall. Clerk, H. E. Hodgins, Farran's Point.

Paris, Ont.
The report published in our issue of February 17th, that the Town Council were erecting filtration plant, is incorrect. No plant will be erected.

Point Grey, B.C.
A Special Committee of the Municipal Council has authorized laying of sidewalks on Fremlin Road, 5th Street, 19th Avenue, Park Road and 11th Avenue. Clerk, G. G. Heighway, Kerrisdale P.O.

Port Hope, Ont.
Tenders will be received by Mr. R. Gray, Secretary-Treasurer to Water Commission, for following work and materials:—

(3) Low-lift centrifugal pumps, motors, oil engine, piping and erection of same.

(4) Venturi tubes, loss of head gauges, elevation gauges.

(5) Construction of four slow sand filters, pump house and pure water reservoir.

(6) Cast iron pipe specials.

(7) Valves and valve boxes.

Plans and specifications at office of Engineers, Messrs. F. W. Thorold Company, 2 Toronto Street, Toronto.

Romney Township, Ont.
The Township Council will repair a number of drains in spring. Clerk, J. W. Kennedy, Wheatley.

Russell Township, Ont.
A contract will be let in June, by the Township Council, for laying drain, estimated to cost $2,700. Engineers, Magwood & Stidwell, Cornwall. Clerk, W. R. Craig, Russell.

St. John, N.B.
The City Council have started laying sewers and water mains on Millidge Avenue and Lime Kiln Road, by day work. Estimated expenditure, $25,000. City Engineer, W. Murdoch.

Vancouver, B.C.
The City Council will shortly call for tenders for supply of material for sewer to be constructed on Clark Drive. Engineer, F. L. Fellowes.

CONTRACTS AWARDED

Assiniboia, Man.
Rural Municipality of Assiniboia has awarded contract for laying 1,135 ft. of 4-in. concrete sewer and 2,815 ft. of pipe sewer on Oakdean Boulevard, to Thos. Jackson & Sons, 370 Colony Street, Winnipeg. Amount, $12,013.50.

Edmonton, Alta.

Toronto, Ont.
The Board of Control have awarded contract for construction of sewers on St. Clair Avenue, to the Moyes Construction Company, 592 Gerrard Street E. Amount, $6,138.

Contract for paving Danforth Avenue, from Westlake Street to city limits, has been transferred by the Board of Control to the Godson Contracting Company, Manning Chambers. Amount, $41,821.

Railroads, Bridges and Wharves

Edmonton, Alta.
City Council is considering expenditure of $6,000 on improving approaches to high level bridge. Clerk, C. E. Cox. Engineer, A. J. Latornell.

The Bassano & Bow Valley Railway Company are about to apply to Legislature for authority to construct line to Coronation. Solicitors, Short, Woods, Biggar & Collisson, 14 Howard Avenue.

The Smoky Valley & Peace River Railway Company will shortly apply to Legislature for incorporation, and power to construct line from junction of Solomon Creek with Athabasca River, to Dunvegan, on C. N. W. Solicitors, Short, Woods, Biggar & Collisson, 14 Howard Avenue.

Kingston, Ont.
Tenders will be received until 4 p.m., March 18th, by Mr. R. C. Desrochers, Secretary to Dominion Government Department of Public Works, for construction of superstructure of two steel through truss highway bridges, and one steel single-leaf highway Strauss Trunnion Bascule bridge, over the Cataraqui River at Kingston. Plans and specifications from District Engineers, Confederation Life Building, Toronto, and Shaughnessy Building, Montreal, Postmasters at Hamilton and Kingston, and above department, Ottawa. Specification from MacLean Daily Reports, 25 Charlotte Street, Toronto.

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An Illuminating and Timely Discussion

What Steps is the Government Taking to Meet the Trade Readjustment of the War?

THE intense interest taken in "the possibilities of developing trade within Canada and the Empire" is shown in a number of contributions published in this issue. The letters have been prepared in the way of a summarized criticism of the symposium of Trade Development which was one of the principal features of our British Empire Number of February 17.

A particularly able presentation of his views is made by Mr. Paul Seurot, of Montreal—a writer who, by virtue of his wide experience and international relationships, is eminently qualified to speak authoritatively. Mr. Seurot enumerates some of the many lines in connection with which he has received inquiries from France. He tells us that in some cases the inquiries have had to do with immediate requirements, but that more generally they have had an eye to future business. In commenting upon the fact that none of the inquiries was solicited, Mr. Seurot touches briefly upon the scope and activity of an "information bureau" —which brings us to the question of a special body. government or otherwise, the idea of which is discussed from various viewpoints by Mr. Wynne-Roberts, of Regina, Mr. L. M. Jones, of Port Arthur, and Mr. A. K. Grimmer, of Medicine Hat.

Mr. Wynne-Roberts suggests that a special association should be organized on behalf of the manufacturers "to collect independent information as to the requirements of other countries within and without the Empire." The other writers are in favor of a Government Commission.

For our own part, we are inclined to think that any attempt to put these suggestions into practice would encroach upon the work of the Department of Trade and Commerce, which, under the able direction of the Minister, Sir George Foster, and the Commissioner, Mr. R. Grigg, has done excellent work of late in opening up fresh avenues of trade for Canada. The Department has Trade Commissioners and Commercial Agents in the principal trade centres of the world, and as far as the outside missionary work is concerned we believe that the ground is fairly well covered—considering the comparatively early stage of Canada's industrial development.

In regard to an expert consideration of the natural resources of the country, it seems to us that a concentrated effort might be made by a small body of experts directed and controlled by the above Department. It must be remembered that practically all the spade work has already been done. Take, for instance, the clay resources of the country: during the last few years the Mines Department of the Government has had exhaustive reports prepared by such men as Mr. Joseph Keele, Dr. Heinrich Ries, and others. Of course, a great many new and untried suggestions have been adduced in our Symposium, but an investigation of these, considered either individually or collectively, appears to be little more than a side issue after all. The first and only effective step that can be taken is to bring before the Government the desirability of taking special measures at this time in order that enterprise consistent with the present opportunities for industrial expansion may be exerted. The suggestions as to manufacturing opportunities can be used only as a means of reinforcing the main argument.

This Symposium has disclosed the fact that in the constructional field Canada has great possibilities of development—and further, that many of the foremost engineers, architects and contractors of the country are willing to give consideration to such development; but, after all, the constructional field, while perhaps the most important, is only one of a number, and the widely scattered suggestions of various "possibilities"—such as manufacturing steel plates and shapes in one part of the country, developing clay reources in another, examining into marble deposits here, utilizing the by-products of coke manufacture there, providing openings for capital in the east and others in the west—are only a means to an end, and we take it that the end is to show that Canada has "possibilities" on a scale not yet realized. It will be interesting to learn from the Department of Commerce whether any special policy is being mapped out in view of the readjustment of the Empire's trade which has been brought about by this calamitous war.

We must confess to a little amazement at Mr. Seurot's revelation in regard to the offer which he received from a Canadian firm to furnish a U. S. railway car built by a German firm under a German patent. The war has not yet been brought fairly home to Canada, and so the degree of patriotism that one might expect is overcome at times by greed for commercial gain. We do not suggest that "patriotism," in the literal acceptation of the word, can be expected in a business deal, but we do suggest, and—in common with the British Government and the British people—we do expect and require, that the people with whom we do business take reasonable steps to ascertain that they are not putting British money into German coffers at a time when British lives are being sacrificed on the altar of German militarism—or whatever other name may be found for the enemy's criminal depravity. In matters of this kind there can be no equivocation, and the experience to which we refer is a matter of regret—particularly in view of the fact that Mr. Seurot is of French nationality.

Why the Engineer Fails of Public Recognition

By Prof. Geo. F. Swain, of Harvard University

IT is an opinion held very widely—particularly among engineers—that the engineering profession is not appreciated at its full value, and that the engineer does not receive the recognition in public life and as a leader that his attainments entitle him to receive. In times past I have not hesitated on various occasions to raise my voice, feeble though it may be, in support of that proposition. I have not changed my views at all. However, it seems to me that possibly by emphasizing it continually, we may overdo a little bit that aspect of the matter, and I am, therefore, going to ask you tonight to take a different point of view with me, and to inquire, if the engineer has not his recognition, what the causes for it are, and how they may be remedied.

Of course, as a purely professional worker, the engineer is always necessary and will always be called upon to do engineering work. Moreover, statistics show that the remuneration which engineers receive is as large as that received by members of the other professions, on the average. It is a question of supply and demand, and the engineering profession is not overcrowded. I feel certain of this from my experience in having turned out a great many young men year after year, and having placed them in positions.

Moreover, happiness and content, real success, service to mankind and to a man's family, do not depend upon money, and are not measured by dollars and cents; they can be obtained just as well when the remuneration is moderate as when the remuneration is very large, and engineers, as a rule, I believe, receive compensation sufficient to enable them to live comfortably.

In my opinion, in recent years the respect paid to the engineer, if measured by financial remuneration, has increased, and engineers now frequently receive very large fees—fees that 25 or 30 years ago would have been considered almost out of the question. However, those fees are not as large as those received by lawyers or doctors, of course, for the reason that the engineer does not appeal to sentiment, which is so potent a factor in the other professions. I presume that fear, love and avarice are the most potent emotions. The law appeals to all of them. Medicine appeals to fear and love. Engineering appeals to none of them. Another potent factor in the human being is vanity. Architecture appeals to vanity. The architect can easily convince his client to put up a costly and luxurious building, upon which he receives his percentage, the percentage increasing as the work is less and less necessary. (Laughter). The architect rightly puts a tax on luxury.

However, these matters will take care of themselves. We are chiefly concerned here with the status of the engineer as a leader in the community, as a moving force, as an administrator or executor, who leads in the solution of great problems.

The suitability of a man for leadership depends upon two things—his knowledge and his personal qualities. Most of the great undertakings today involve engineering; most of them, to a very great extent. We recognize this. We know that we live in an age of applied science.

Law and business are equally necessary in the solution of these undertakings. There is no more reason, inherently, and no less reason, why the engineer should lead and be the employer any more than why the lawyer or the business man should lead and be the employer. It gets down, therefore, in the end, to the matter of personal characteristics. The lawyer or business man with personality can easily lead, and can hire the engineering brains and knowledge, just as the engineer, if he have the personality, can lead and can hire the legal and the business brains and knowledge.

If, therefore, the engineer does not lead, it must be because he lacks personal qualities, and if he lack the personal qualities, he ought not to lead. There is no mystery about it, no injustice. By personal qualities I mean character, presence, tact, ability to handle men, breadth of mental vision, and mental training.

Some of these qualities are inherent, and others are developed, more or less, by training and experience. There is no reason to believe or to assume that one class of men in the same country and at the same epoch are inherently superior in regard to personal qualities to any other class. Haye we any reason to suppose that the engineers are inherently superior to the members of other classes in this country? It does not seem to me that we have. What indications there are might be considered to point the other way.

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* From an address delivered last month at the Convention of the American Institute of Electrical Engineers.

This is a matter upon which a person cannot speak at all positively or dogmatically, but I have talked with a good many college graduates as to what becomes of the men in their classes, and I have been rather interested to find that they almost all tell me that the ablest men in their classes go into law or into business. One thing, therefore, we must do is to induce young men of ability and character to become interested in engineering and embrace it as a profession. We can all of us do something in that direction.

The problem is then reduced to this further question—whether the personal qualities that come by training, or are developed by training and experience, give to engineers, to the engineering profession, preeminent qualifications for leadership. Those qualities which are influenced by training and experience are mental grasp, ability to reason, capacity to discern truth, desire for truth, and ability to deal with the human element. It is generally claimed that the engineer should be particularly fitted, not only by his knowledge, which matter I have already referred to and disposed of, but by his training, making him able to think straight, to have a breadth of view to discern the truth, a desire to get at the truth, and the ability to know the truth when he has got at it.

Now, how true are these claims? Do engineers think straighter than lawyers or business men? No positive statements can be made. Of course, I am speaking generally, and there are exceptions to any statement that can be made, but I doubt whether engineers as a class think straighter than lawyers, especially, or the well trained and experienced business man. The training of the lawyer in the exact meaning of terms is one of the most important factors in making him think straight. We all know that misunderstandings and errors in reasoning come about because the exact meanings of the words or terms we use are not understood. The lawyer is continually concerned with getting at the exact meaning of words. In drafting statutes, in drawing wills, in all his varied work, that is one of the practical courses of discipline which he goes through—and there could be no better discipline.

Moreover, no man understands a question if he can only state it from the positive point of view: he must also be able to state it from the negative point of view; he must see not only what it includes, but what it excludes; he must see not only the arguments in favor of it, but the arguments against it. In that matter, the lawyer has a most excellent training. When he assumes a case he puts himself in the position of his adversary and exerts his wits to the utmost to discover the weak points in his own case. He tries to discover every argument that can be brought up on the other side, and then prepares himself to meet it. I somewhat question if engineers in their experience go through quite as good a mental discipline as that, or whether in the schoolroom they get anything that is quite as good a mental discipline.

I think, therefore, that the legal training and experience, on the whole, train men better to think straight and reason logically than the engineering training. The single objection to the legal training is that the lawyer is apt to become an advocate. But still we all know that there are many, very many, capable, high-minded lawyers who will not take a case unless they believe that they have the right.

Now, how about breadth of view? Can we say that the engineer's training and experience give him greater grasp of subjects and greater breadth of view than those of the lawyer or the business man? Here again there may be doubt, but I similarly question whether today, and in the past, the training of the engineer has given him as much a grasp of subjects and a breadth of view as the training of the lawyer and the business man. I fear that the engineer concerns himself in college, and after college, too much with the minor technical details of his profession, and does not accustom himself to study, does not take interest enough in the consideration of the broad questions affecting the community in general. I know that is so in the colleges. I know that the young men get interested in the purely technical details, and that it is very difficult to get their minds away from these things to any large extent.

Business and Engineering

I am a great believer in the business man, and I believe that his experience, bringing him in contact, as it does, with law, with engineering, with all the varied activities of life, is a very excellent training. I should like to see more engineers in Congress, I should like to see an engineer become the President of the United States, but I should like to see, for once, a really good business man in the presidential chair. (Applause).

Instead of complaining, then, although it is true, that the engineer is not recognized, I urge that we try to realize that there is a cause for it. We live in a world of natural law. For everything that is, there is a cause, not only in the physical world, but in the mental and the moral. Let us find the cause, if the engineer be not recognized, and the remedy.

Among the things I think we can do are the following: We can exercise our influence to bring the facts in regard to the engineering profession, its possibilities, the high character of its work, to the attention of our students and to induce the able young men of the coming generation to embrace the engineering profession. In the second place, we may influence technical education and try to secure a broader curriculum, with more attention to fundamental principles and less to technical details which the graduate must learn in the field after he graduates and which he can learn a great deal better there than in school. Let us insist on a training in the English language, so that our engineers shall not only be able to speak and express themselves properly, but be able to write a proper report, and therefore impress upon people with whom they come in contact that not only are they qualified in their engineering specialty, but that they are able to mix with men and deal with large questions in a comprehensive way.

I agree entirely with what has been said in regard to mathematics. I think the fact that engineering is to so large an extent a mathematical subject is one of the main reasons why the engineer is not recognized. In my opinion, there is scarcely anything that tends more to narrowness of view than dealing all the time with problems that can be solved only by right mathematical processes, because the great questions which confront us are not mathematical; the data are shifting, variable, and the human element comes in. Therefore, the man who is accustomed to solve his problems by mathematics, and can only do the solving in that way, finds himself at a loss in the practical affairs of life—mathematics do not apply. We should seek to broaden the minds of our engineering students by study in history, literature, psychology and other subjects which give a broad outlook upon life.

I urge, therefore, that in these ways we help to give the engineer of the future the personal qualities for leadership. We may rest assured that if he is possessed of these qualities, leadership will come to him.

Trade Developments in the West

Specially Contributed by Jas. McDiarmid, Winnipeg

DESPITE the comparatively small amount of building required this year, it does not seem as if there will be any material difference in the cost as compared with 1913-14. While labor conditions may vary in certain districts, owing to a small demand and local differences, it is not at all likely that the rate of wages will be altered to any extent, nor can there be any great change in the cost of building material as a whole. Cement—one of the largest items in modern building construction—will cost the same as in previous years, unless there is a further reduction in the rate of duty on this material.

Brick has not been a profitable business in this western country during the last few years, and a reduction in price can scarcely be looked for. The competition in this branch has been exceptionally keen, despite the large demand, and a reduction in price would undoubtedly mean closing out a number of these concerns now doing business.

Another important item in building is lumber. As freight charges are responsible for over 50 per cent. of the cost of this material to the wholesaler, the likelihood of any reduction on this account is very remote. For the last ten years, the price in the West has been determined by competition from the States and with their larger markets and greater output, prices are not so easily affected. On the other hand, the lumber business in B. C. during 1913-14 has not been at all profitable for the manufacturer. Several important concerns have gone into liquidation and a greater number have closed down until conditions improve. Possibly less than 40 per cent. of all those engaged in the manufacture of lumber in the west have held their own during these years, and while, no doubt, some material can be bought at forced sale prices from existing stocks, B. C. manufacturers cannot quote lower prices than 1913-14 and stay in business. The competition from the States in the lumber trade is scarcely legitimate. In contrast with a 35 per cent. duty in favor of the cement manufacturer, the saw mill men in the west have no protection whatever against foreign competition, while wages for common labor in B. C. are $3.00 a day, as against $2.00 in the Western States. He has also a comparatively small and uncertain market cumbered with a credit condition which necessarily entails serious losses upon the manufacturer in such times as these. Consequently, with lumber below cost in 1913-14 there is scarcely any likelihood of a lower price for 1915-16. To those whose knowledge is restricted to the vagaries of the retail trade these statements may seem unreasonable, but with American dimension lumber quoted to wholesalers and others at $17.50 to $19.00 f.o.b. cars at all available points, after allowing freight charges averaging $9.00 per 1,000 ft. the B. C. manufacturer does not receive a fancy price for all his work—logging, sawing ,piling, dressing, loading on cars, selling and collecting expenses, and probable losses. The Canadian manufacturer has been forced by this foreign competition to dress down dimension lumber, in order to save weight, to a point detrimental to the buildings in which lumber is used, so that at the present time 2-in. dimension is only 1⅝-in. thick, and American dimension is even less, running slightly over 1½-in. in thickness. This is a matter of serious difference between the architect and the contractor, times without number, and some effort should be made to standardize 2-in. dimension at not less than ¼-in. scant as the difference in freight would only increase the cost from $1.00 to $1.50 per 1,000 ft., and a change of this nature would be in the best interests of all those connected with the erection of buildings as well as the interests of the Canadian manufacturer.

Steel will be somewhat lower than in previous years, but other materials will not be greatly affected one way or another, excepting copper, and the cost of this material is increasing very rapidly just now.

The present unfortunate war is in no way responsible for the conditions of the building trade and were it over to-morrow there would be no improvement. All the western cities are built ahead of the development of the agricultural interests of the country and until there is a more even balance there can be no legitimate demand for city building. This depression will no doubt be to the advantage of the country as a whole, sending back many to the land and closing down to a large extent this parasitical business of the real estate gambler and all such fakers who persuade themselves and others that a country's growth is not governed by economic laws. Should this war continue for a year or two the agricultural interests of this country would make greater progress than under normal conditions. Upon this progress depends the early solution of the present depression in the building trades.

Limiting the size of heavy motor trucks and their loads, an ordinance recently formulated by the city of Chicago law department provides among its restrictions that all trucks shall have rubber tires overlapping steel tires; that the weight of vehicle and load shall not exceed 750 lb. for each inch of tire width, the maximum weight allowed being 28,000 lb.; that for freight-carrying purposes no truck shall be more than 90 in. wide or 26 ft. long, and that for passenger-carrying purposes, 8½ ft. should be the maximum width. Speed of trucks is to be based on capacity and will range from 6 to 12 miles an hour. Loads shall not project more than 4 ft. past the rear end of the truck, except during early morning hours and late at night. The ordinance has been presented to the city council judiciary committee, and a copy to the local transportation committee.

Cinders, when used as aggregate in concrete, should be of good, clean, crushed, vitrified clinkers, as the ordinary cinders are unsuitable for such purposes. Cinders from anthracite coal are usually the best, owing to being harder, generally more dense and less liable to contain injurious amounts of sulphur.

City Engineers' Annual Reports—How They May be Improved

NOT infrequently among Canadian municipal engineers one finds a man well posted on the practical details of his work, but woefully lacking in the ability to do himself and his department credit in setting forth the details of the year's activities. This comes in part from disassociating oneself from the work of one's fellows and refraining from contributing to the work and discussion of technical societies and journals. Nowadays the engineer must have something of the newspaper instinct. If he is to do himself justice he must be able to prepare descriptive matter readily and give due prominence to outstanding features calculated to impress the particular community that he is serving. A suggestive commentary upon this matter is made in the following editorial taken from a recent issue of The Engineering Record.

At the outset it is pertinent to inquire, "What is the object of an annual report?" It would seem, primarily, that an annual report should tell the taxpayers what has been done with their money during the year. A secondary object is to place on record data of engineering value so that by exchanging reports with officials of other cities the experiences of one locality may be made available for the solution of similar problems elsewhere. If this be correct, it is necessary to consider how this information can best be conveyed to those for whom it is intended.

Engineers have apparently proceeded on the assumption that their task is done when they present the results of the year's work in the form of a colorless statement of feet of water main laid, and square yards of pavement resurfaced, accompanied by page after page of tabular matter, showing the minutest details. The reason for this conception of the form of a report is not difficult to find. The engineer does not set before himself clearly its purpose, he does not form a concept of the character of his audience, or if he does he lacks the skill necessary to present his facts in a convincing manner. But, fortunately, ideas are changing. Any one who has followed the trend of thought as expressed at meetings of engineering societies recently must realize that the demand for proper recognition of the engineer's work is growing more insistent, and that the help to be secured from properly prepared reports is being appreciated.

Every report should begin with a summary, in non-technical language, giving the achievements of the year. In this summary, intended primarily for the taxpayer, only the larger phases of the work should be dealt with. It is a mistake to dilate upon details or routine matters. The outstanding events of the year should have first attention and then the broad questions of policy which have influenced the department. The purpose of the engineering structures being built and their effect on the physical development of the city must be brought out clearly. The public will be interested in these things, if told in simple, non-technical language.

Often the opening sentences of a report commend or condemn it. One report, recently received, opens with the sentence, "The city of ———— lies in latitude ——— and longitude ———." This report then goes on to list the names of the railroads entering the city. There is no surer way of killing the reader's interest. If the city is spending thousands of dollars on a new sewerage system and treatment works, as this one is, why not start with a description of this all-important work? Who cares for a reiteration of a city's latitude and longitude when there are matters of more immediate interest at hand? By the inclusion of such superfluous material important archievements are obscured—and yet engineers wonder why their efforts are not appreciated.

Then again, consider the question of tabulated data. This journal can see no reason for filling dozens of pages with tables showing the number, size and location of valves. This information is valuable. Its place, however, is in the office files and not in a report sent out broadcast. The same observations apply to statistical matter on hydrants, pipe, meters and street paving. A summary is desirable, but detailed tables are a waste of space. Worse still, they make a report forbidding and insure its neglect by those who should read it.

When certain bureaus—such as a sewerage-testing station, or a street-cleaning division—have accumulated especially valuable or interesting material, the data are best put in an appendix, and only a summary of results in the general report.

Finally, copies of the introduction, by itself, should be sent simultaneously to all the local newspapers, at the same time offering to give them detailed information on any subject referred to in the report. Some engineers are adverse to such procedure, but since the object of their report is to place the operations of their department before the public, they should accept the most satisfactory medium—the daily press—for securing the desired publicity. In some cities—Philadelphia, notably—this idea has been grasped, much to the benefit of the public and the department in question.

Twenty-five Millions for Quebec Roads

THE Legislative Assembly of Quebec have passed the Bill for raising $5,000,000 for good roads. The effect of the act is that the Lieutenant-Governor-in-Council may authorize the Provincial Treasurer to contract from time to time, for the carrying out of the good roads programme of 1912, one or more additional loans to an amount of not more than $5,000,000 over and above the amount already authorized. This makes a total of $25,000,000 for the improvement of roads in the province. There was some criticism of the Government's road policy, it being alleged that the share of the cost of road-making borne by municipalities exceeded by from two to three thousand dollars a mile the original estimates.

Information supplied by the Government dealing with the provincial highways which the Government itself is building shows that the King Edward highway cost $654,340 for 39 miles; Montreal to Quebec highway for forty-four miles, cost $1,311,451; the Derby to Sherbrooke road for only one mile and a half cost $119,050, but this was explained by the fact that bridges and culverts were necessary, whereas other roads ran through level country; the Chambly road, eighteen miles, cost $47,399, with two more miles to build. Altogether the Government on its provincial highways programme has built forty-six out of seventy-three miles since 1912, and the total cost has been $2,096,697.

For most purposes where trussed arch centering is used, a slight camber may be assumed equal in amount from 1/1,000 to 1/500 of the span. Some engineers make an allowance for settlement equal to ¾ in. for each 30 ft. vertical height.

No steel reinforcement should be painted or oiled, as either treatment will lessen the adhesion of the concrete. No grease or foreign matter of any kind should ever come in contact with the steel.

"The Possibilities of Developing Trade within Canada and the Empire."

Discussion of Symposium on this subject published in our British Empire Number of February 17 last.

Never Such Another Opportunity

Kamloops, B.C., March 1, 1915.

Editor Contract Record:

Your Symposium on Trade Development Within the Empire is suggestive in many particulars. After reading the contributions of the various departmental heads, and others representing manufacturing activity in every province of the Dominion, it only confirms my impression that if the citizens of Canada, and the manufacturers of Canada, are true to the highest principles of Imperialism, there can never be such another opportunity as that of to-day for the expansion of trade within the Dominion, and without the Dominion within the Empire.

Yours very truly,
ERIC G. KINGWELL,
(City Engineer).

* * *

Careful Investigation Required

Peterborough, Ont.,
Feb. 22, 1915.

Editor Contract Record:

I have read with great interest in your issue of February 17, the symposium on Trade Development. There are a number of exceedingly good suggestions, but judgment must be used as to their application. We have wonderful natural resources waiting to be developed, and a market must be developed for them. This will take time and money, and it will be a long time before some lines will pay dividends.

In my opinion, the first thing to make sure of is whether or not there is a market for the article we propose to furnish. Then what price will the article bring. Lastly, at what price can we produce a first-class article and deliver it for?

In other words, can we compete with present producers of the same article. The whole question is one that requires the most careful investigation and study.

Yours truly,
R. H. PARSONS,
(City Engineer)

* * *

A Government Commission with Empire-Wide Scope

Port Arthur, Ont., March 2, 1915.

Editor Contract Record:

I have read with a good deal of interest in your Empire Number the articles regarding "the Possibilities of Developing Trade within Canada and the Empire."

It is evident from the tone of these articles that the authors are agreed upon the point that the present time offers bright opportunities along the line of trade development. There are thousands upon thousands who think and agree likewise; therefore, the next step is to bring about the condition required and to maintain it when once secured.

How can this best be done? In reading the articles I was impressed strongly with the suggestion of the formation of a Commission to take this matter in hand. The Commission for this purpose should be one appointed by the Government, for the reason that the other countries concerned would, in all probability, become more interested by the efforts of governmental authorities than by a body of men not under such control. Also, as an Empire-wide proposition the basis adopted in each country should be practically similar, in order that reciprocal relations might be properly established.

As to who should be the members of this Commission is a question, but one thing is certain: the men should be chosen for their ability, breadth of vision and knowledge of conditions. Probably it would be a good idea to have a member representing each province.

Every town and city throughout the Dominion has knowledge of its possibilities along industrial lines and information regarding the natural resources of the respective localities, so that upon application to the Mayor or President of the Board of Trade all such information could be had by the Commission.

When we have achieved what we desire in this respect let us adopt the old motto of Britain, "WHAT WE HAVE WE'LL HOLD," with the additional words—"AND ADD TO."

Yours sincerely,
L. M. JONES,
(City Engineer).

* * *

Favors the Idea of a Government Commission

Medicine Hat, Alta., Feb. 27, 1915.

Editor Contract Record:

A careful perusal of the articles appearing in your issue of February 17th can leave no doubt in the mind of anyone that each contributor realizes that Canada controls wonderful resources, which, as yet, have not been developed to the extent that they should have been. Each contributor, however, is like myself—in an indefinite position as to the extent of these resources and the volume of business that would be available were they developed.

We all realize that there is no question that many industries could be developed with great benefit to Canada and the Empire. This development, however, must be along sane and scientific lines if it is to be beneficial to the community at large and to the stock-holders in the proposition.

It would appear that the development of trade within Canada and the Empire could be well divided into two headings. First, we have the turning of a natural resource into a product which of itself, or by combination, is suitable for the manufacture of sundry materials and appliances. These might be known as primary or basic industries. Second, there is the development at local points of smaller enterprises which would use the primary products as a basis of their product. These might be styled secondary industries.

The consideration for markets, location and manufacture for primary industries would be a matter for much greater study than that with respect to the location of secondary industries.

In my opinion the only satisfactory way of handling the problem is by means of a permanent industrial commission which would devote its whole time and attention to the subject and not be influenced by local prejudices. The result of its studies would be of great benefit to the Government in the formation of an industrial development policy. The proposed commission would be able to advise the Government as to the protection required by various manufacturers. In this manner the Government's protection would be a competitive protection rather than a protection with the idea of producing a definite revenue for Canada.

Yours truly,

A. K. GRIMMER,
(City Engineer).

* * * *

Montreal Engineer's Forceful Presentation of Many Industrial Opportunities

Montreal, March 3, 1915.

Editor Contract Record:

The various articles on the Possibilities of Trade Development published in the Empire Number of the Contract Record and Engineering Review are extremely interesting and timely contributions. The "possibilities" which have been pointed out are in most cases unused wealth or resources, or disseminated efforts and activities, which only need to be centralized.

The writer has been so placed within the last few months that inquiries have come to him from France for the immediate acquisition of needed materials and also with a view to establishing future trade relations, not only in lines which would naturally be most interesting to engineers, such as structural steel, rails, railway track and equipment, but in almost every line, from knitted goods to benzol, from wood pulp to graphite, from leather to methyl and bronze powders. And so far all these enquiries from France have come from manufacturers or dealers who, in a few cases, need certain goods at the present time or, more generally, have stated their desire to buy in the future from Canada or from other parts of the British Empire what heretofore they have purchased in Germany or Austria. These enquiries were not sought for and this only shows that there is, in that direction, for Canada, a wide field to develop and that it might be useful to create some sort of information bureau or commercial agency—a clearing house, as it were—to solicit such trade and centralize and direct all these enquiries.

Unfortunately at the present time there are many lost opportunities. The nickel question, which was the subject of an article in the Empire Number, is one of them. The Toronto newspapers, the Montreal Journal of Commerce and several English papers have pointed out the danger of nickel being diverted from the New Jersey ore refinery. Some papers have even stated that the Krupps from Essen controlled the stock of the New Jersey International Nickel Company. The Canadian Government supervision over the exports from this plant seems to be something of a delusion, and a glance at the United States customs report shows that after deducting the nickel which has been shipped to Great Britain there has been an unusual increase in the exports of nickel during the last six months, which shows that nickel must have gone where the allies had the least desire to have it exported. It is obvious that this could not have happened if there had been an ore-refining plant in Canada, and in any case it seems strange that the country which is the largest producer of nickel in the world should depend on another country for the refining of the matte and deprive herself of that source of revenue. Strangely enough the Canadian Mining Journal is the only paper which seems satisfied with the present conditions. Its policy may be prompted by a genuine fear that any restrictions on the exports of nickel ore would be temporarily detrimental to a Canadian industry; it may be shortsightedness, however, and its campaign against the installation of a nickel-refining plant in Canada might lead one to infer that if the stock of the International Nickel Company of New Jersey is controlled by Germans, the latter may have some interests in the Sudbury district as well. Of course, it is too late now, as far as the war conditions go, to install a refining plant, but this is one of the possibilities of the near future.

Mr. John S. Archibald in his remarks on "The Manufacturer and Patriotism," very ably pointed out that the Canadian-made article must be Canadian-made throughout. Canadian houses must manufacture here and not be merely commission agencies selling American articles. About a month ago the wrier had occasion to invite bids for railway material and equipment for the French railways in Morocco. Among the bids received was one from some Canadian firm offering railway cars built in the United States by a German firm under a German patent. It is expecting too much of a French corporation to buy German goods via Montreal to build up Morocco.

Mr. Archibald is quite right in asking the manufacturer to endeavor to reduce the initial cost of production. In creating a standard article, the manufacturer must learn to establish his own price and not merely add to the cost of his article the cost of carriage and the duty, say, from Pittsburg or Cleveland. There lie some of the best opportunities of the manufacturer.

The writer had occasion to inquire as to the export of benzol. This article, if considered as a by-product of mineral oil, is included by the Royal Proclamation of August, 1914, under the head of Petroleum and its by-products, among the articles which cannot be exported. Petroleum and benzol, at any rate, come from the United States and may better be exported to Europe from some of the American ports; but benzol may be obtained also by the distillation of coal tar after the distillation of gas and as such probably would not be considered as one of the prohibited articles. However, the gas plants hereabouts are not equipped for the distillation of these by-products. Why such waste?

In regard to coal briquetting, it may be pointed out that while the production of coal in Canada for the years 1912-1913 amounted to $72,269,335, the imports from the United States amounted, for the same years, to $80,486,773. There was, therefore, an excess of imports over home production of $8,217,418. While it is not claimed that the imports of coal could be dispensed with, yet there is no reason why the manufacture and use of briquettes for commercial and domestic purposes, utilizing run-of-mine coal, dust and waste.

could not more than redeem this difference of over $8,000,000.

Commissions on Conservation have been advocating the use of sawdust. A very simple way to utilize this waste is to briquet it and use it as fuel. The saw mills in the forest districts on the slopes of the Vosges are making sawdust briquettes by mixing it with pitch binder under high pressure.

There are possibilities of trade development in almost every branch of commerce and industry, and it seems that it is only necessary to centralize and co-ordinate so many efforts which might otherwise spend themselves without an ultimate result.

Canada has been called the Germany of the world. Beside agriculture, her natural resources in minerals, forests, water power are almost unlimited, and the time seems opportune now to use all this natural wealth in the development of the country. There is no reason why from now on Canada should not secure an important share of Germany's export trade. In 1912 this trade amounted to 3,708,000,000 marks ($927,000,000) in exports from Germany to Great Britain, France, Belgium and Russia; to 1,943,000,000 marks ($485,000,000) in exports to countries beyond the seas, and to 2,370,000,000 marks ($592,500,000) to European neutral countries.

Yours truly,
PAUL SEUROT.

* * * *

The Possibilities and Limitations of Our Great Industrial Opportunities

Regina, Sask., March 1st, 1915.

Editor Contract Record:

In the first place I desire to commend the effort made to concentrate public attention on such an important question. I may say that I am not engaged in trade: I am like Mr. Dodwell—merely an ordinary civil engineer—interested in the commercial growth of the Dominion.

There are points touched upon by various contributors which deserve consideration. Undeveloped or partially developed industries, such as certain clays and infusorial earths, marble, slate, timber, beet sugar, and so on, offer fields for great enterprise and good investment if they are organized properly. As the writers have stated, we import immense quantities of goods in these lines, while in many places the raw materials lie waiting to be utilized, and a market is at hand. In the days of former prosperity money was made more easily in other ways and consequently these avenues of permanent wealth were either overlooked or ignored. Exotic schemes, however, received attention because the promoters were pushful.

There is a sentiment, often expressed in the articles, that local resources should be developed. There is a potential source of wealth at the gates of almost every city, but it is not the same in all. There are not many Pittsburghs in the world, for the reason that the local raw materials are not coal and iron. But some have clays; others have wood or stone, and so on. In some instances the sources of wealth are hidden and have physically or metaphorically to be dug out. Mr. Henry Dalby referred to several cities identified with characteristic industries. Many others could be named, and in practically all of them, such industries could be started in a small way.

There are potential industries in the utilization of waste or by-products. Mr. C. C. Clark has named some. Why should not the Westerners utilize the straws that are now annually consumed by fire? Flax fibre, in huge quantities, is destroyed each year in a similar manner. There are processes available or to be found by which these inexhaustible supplies of raw material could be converted into commercial commodities.

Your London correspondent refers to eggs imported into Great Britain. It may be stated that an enormous quantity was received from the Black Sea provinces of Russia. Canada is nearer to that market, but the quantity of eggs exported is small. Reference was made to poultry, etc., and garden produce might be mentioned.

There is an almost unanimous note of pride in the articles with reference to the resources of Canada. Some writers have pointed out the need for technical training to develop such resources. Although there are other countries which have done much in the application of scientific methods in the utilization of raw and waste materials and by-products, Germany has more often been held as the example. Canadian institutions are doing great work in the training of men in the science of useful arts, but I firmly believe, and the professors themselves will admit, that there is not sufficient intensive study to do more than follow the example. The magnetic attraction of the dollar is perhaps stronger than the drudgery of research work. There is abundant scope for researches which are essentially Canadian in character. Canada is young in the scientific world and so is Modern Germany. There are new compounds to utilize, new processes to devise, and new competitive conditions to meet, and the nation that furnishes them is the one to succeed. Restrictions due to tariffs are often circumvented by cheapened processes and by the utilization of waste products. Patriotism, loyalty and other desirable virtues are evanescent and will be cast aside by "human nature" when profits are to be considered.

Many of the writers have referred to "freer exchange of information," trade reports, exhibition of samples, co-ordinated efforts, co-operation, organized financial support, and so on.

The Department of Trade and Commerce is doubtless doing a great deal to assist the manufacturers; nevertheless, there is much the manufacturers can do for themselves. Mr. W. M. Currie expressed the opinion that free exchange of information between the manufacturers would develop much business between themselves. This is rather limited in its operation. Mr. Dalby described the co-operative principle of German business, which no doubt in some measure explains their phenomenal expansion. I may mention that a number of large manufacturers in Great Britain formed an association to collect information from various parts of the world, and this organization has done good work. This is the first fruit of combination.. Mr. Dalby also referred to the Cartel and Syndicate of Germany organizations—one to regulate the prices and terms, and the other to make the actual sale. There is still the element of concentration—that is, concentration on the manufacture of the commodity for which a district or firm is best adapted.

The manufacturers already have an association—The Canadian Manufacturers' Association—representing them and protecting their interests. This association—or if needs be another one—could collect independent information as to the requirements of other countries within and without the Empire. I have my opinions on this subject, but there are many others who have theirs, and it would ill become an outsider to assume the role of an adviser on the matter.

Although reasonable space has already been exceeded, the matters of "industrial commissions," bulletins of production, etc., referred to by some contributors, are topics worthy of discussion. If industrial commissioners are to investigate how certain materials can best be used, how to cheapen the processes—in short, if the work is carried out more or less on the lines of the United States Bureau of Standards and the British Physical Laboratory, then some good may result therefrom; but if it is simply to promote business connections and development, then the present Department of Trade and Commerce already appears to fulfil that function.

Yours truly,
R. O. WYNNE-ROBERTS.

* * *

The Viewpoint of a Ceramic Engineer

Toronto, March 3, 1915.

Editor Contract Record:

The viewpoint of many of the contributors to your Symposium is interesting to me, but there are one or two observations which I should like to make. From the remarks made by one of your correspondents, one would gather that the consumer was the only patriot and that the manufacturer was little better than a fraud. This writer speaks about the "necessity of fostering home industries, and says, "Let the manufacturer turn out goods of such a quality that they will command a market, irrespective of the flag."

It is certain that the consumer will not pay $1.25 for the Canadian-made article, when he can buy the German product for 75 cents and the English product for $1. There is no avail in the argument that the wages earned by the Germans would be no good to Canadians. This is a matter for Canada to adjust by protective or other measures. It is held that certain classes of goods are protected, when they are inferior in quality and should be placed on the free list. Certainly the remedy for these things is healthy competition. If we make a point of buying the best article, everyone will have to hustle to get his share.

I would cite the case of pressed brick. If protection were removed from this line Canada would be a dumping ground for all and sundry manufacturers in the United States, and before long the Canadian trade would be virtually annexed to that of the people of the other side of the border. If there were abundance of cheap fuel, the conditions would be reversed and the protection would be on the other side. We are enjoined to reduce the initial cost of production, but it seems to me that we are down to bedrock cost now, as a visit to the factories at LaPrairie, Don Valley and Milton will prove.

We are asked to manufacture an article "not equal to, but better than that of our competitors." My own viewpoint is that Canadian manufacturers in the clay industry are to be commended for the wide variety of ware that they are placing on the market. Moreover, a great deal of useful research work is going on, and hardly a day passes that does not witness some fresh development. An idea of the progress that is being made can best be obtained by a visit to the Mines Building, Toronto, where Mr. Joseph Keele, who is well known to readers of the Contract Record, is examining and testing shales and clays from all parts of the Dominion. Such work cannot be estimated in dollars and cents.

Closer relations with the Mother Country brought about by the tariff schedule would be beneficial to Canada. At present, what is free to Great Britain is free also to Germany and the United States, the result being that all, or nearly all, of the refractories required come from the United States.

Yours very truly,
D. M. DUNCAN.

Chloride of Magnesium

Mr. J. B. Mitchell, Commissioner of School Buildings, Vancouver, sends us a further communication in regard to the suggestion which he made in our Symposium on Trade Development, published in our special British Empire Number of February 17th. In that issue Mr. Mitchell directed attention to the fact that in several new schools the specifications called for jointless flooring which is being used very generally on buildings of reinforced concrete. Mr. Mitchell writes, "Into this flooring chloride of magnesium enters largely. This, it appears, is manufactured in Germany, although the raw material is said to some from the province of Quebec. Surely, there is an opportunity here for some enterprising person."

Mr. Mitchell now writes us as follows:—

Winnipeg, February 24, 1915.

I have endeavored to get as much information as possible, and I have learned that the matter has been laid before the Manufacturers' Association with the request that they look into same, but so far no results seem to have been made public.

I understand that with regard to the material from Quebec, the objection is that it contains too much lime, and this would require to be eliminated. The present supply is being received from Greece and the cost is such that a very wide margin is left, which might be used to improve the condition of the Quebec material. This, of course, would mean that the chemists would require to go carefully into the composition of the flooring in order to determine the proper composition, and how best to arrive at it. It seems to have been the employment of chemists with painstaking methods which has brought the German product to the fore. There seems to be such a wide field for this flooring material, when taken in connection with the large number of fireproof buildings which are being erected.

Yours very truly,
J. B. Mitchell.
(Commissioner of School Buildings).

Manganese-removing algae have been developed in the water supply of Dresden, Germany, which is obtained from wells and causes trouble from a black deposition of manganese. Two sets of filters are used, stated Dr. Edward Bartow, in a recent paper read before the Illinois Section of the American Water-Works Association—one a gravity system containing the algae and the other pressure filters depending on manganese permutit for their action. While both processes work, the manganese removing organism makes the gravity system the more economical.

Part of the plant for constructing concrete roads in Fulton County, Georgia, consists of bottomless measuring boxes for sand and stone. They have the advantage that they can be used with any wheelbarrow. Thus the trouble of building special wheelbarrow bodies for careful proportioning is avoided. Moreover, only a comparatively few of these boxes are needed, whereas under the other plan a box must be built for each wheelbarrow.

Wrought-iron and steel pipe and boiler tubes to the extent of approximately 2,245,532 gross tons were produced in the United States during 1913, according to a bulletin issued by the American Iron and Steel Institute.

Mixing, Curing and Placing Concrete with High Pressure Steam*

By Harold P. Brown

THE ideal concrete of the engineer and builder should be of uniform, monolithic structure with the strength and density of granite. It should be as waterproof as asphalt and as flame-proof as fire clay. It should be mixed with only the proper amount of water, yet every particle of cement should receive perfect hydration. There should be no pause between the mixing and placing; from the moment the water touches the cement until the concrete is poured into its final position, there should be continuous and thorough mixing. No crevices should be permitted between successive pourings, nor should there be any cracks or voids. The pourings should be followed by heavy tamping, but not a stroke should be allowed after the initial set. Perfect adhesion should be secured to all reinforcing steel and to all earlier work.

At very reasonable cost, these ideals have been realized by the process and apparatus to be described in this paper. The resulting product weighs more than 170 lbs. to the cubic foot; it has 3 to 4 times the strength of average concrete, and is to a certain extent, crystalline and vitreous in structure; it has a fine appearance, a good color and will take a high polish.

In ordinary concrete work the amount of water is often left to the discretion of the man in charge of the mixer, who is apt to use an excess to secure easy mixing and pouring and quick cleaning. This excess of water gives abundant chance for voids and cracks. If the concrete is poured into barrows and wheeled to its place, the jarring during transit causes the stones to settle to the bottom; the tilting of the barrow does not restore the mix, since the stones are the last to fall. To secure easy flow, when concrete is hoisted in buckets and conveyed in chutes, too much water is often used; or if the amount is correct and a steeper pitch is given to the chute, the water may rise to the surface, leaving the slower moving concrete to get a part of its initial set. The water, the mortar and the stones then fall in partly separated layers, and even the most thorough tamping cannot secure a proper mixture. The usual tamping is poorly done and does not produce solid, waterproof work, even when the best materials have been used. Many bad cracks between separate pourings occur in nearly every job because the precautions necessary to obtain a fair bond are seldom taken.

It has long been known that the tensile and crushing strength of concrete blocks could be increased after their final set by treatment for several hours with steam under high pressure. The heat probably causes more or less opening of the pores and the pressure forces the moisture into the structure and completes the hydration of the cement. Mr. Rudolph J. Wig, of the United States Bureau of Standards, has made many careful experiments in this line, and Mr. H. J. Force, Chief Chemist of the Lackawanna Railway, has reported similar effects upon cement-sand briquets treated in the auto-clave. To prevent freezing of work it is common practice in winter to heat the concrete materials before mixing, and even this has produced a slight increase in strength.

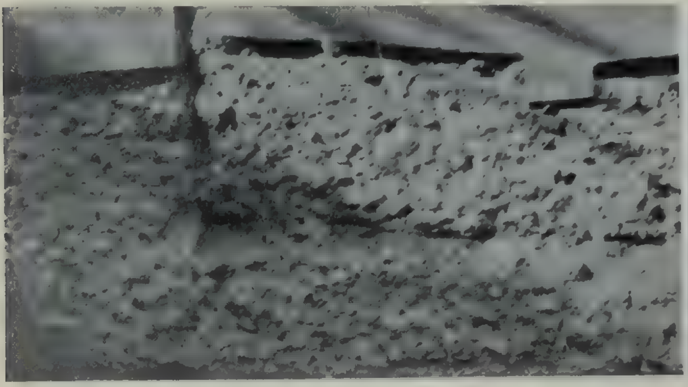
Fig. 1.—Hole in retaining wall on Lackawanna Railroad.

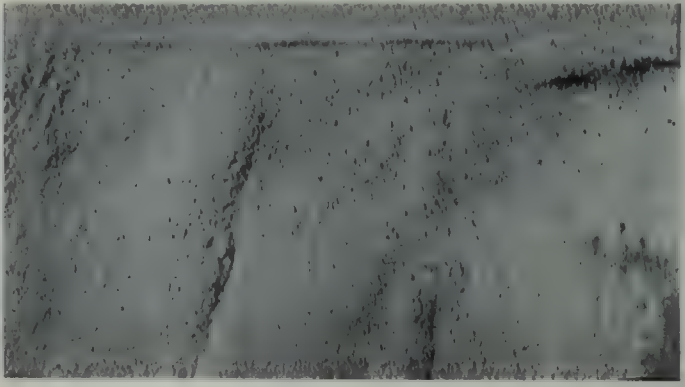
Fig. 2.—Wall repaired with steam-jetted concrete before screeding.

My process consists in thoroughly mixing measured amounts of cement, sand, broken stone and water in a cylinder which is then filled with a hot gas or vapor under high pressure. Perfect hydration is thus secured and a most effective chemical action is set up which gives the product entirely new qualities. When the proper pressure and temperature have been reached and the curing process is completed, the outlet valve is opened and the plastic concrete is dropped into a superheated stream of rapidly-moving gas or vapor. The wet particles are separated from each other and can be carried several hundred feet in a rubber-lined hose to the point of deposit, which may be many feet above the mixer. The stream is projected through an expansible nozzle and strikes the work at high speed, thus tamping it and securing unusual density and strength. The blow jars out part of the water, and the high temperature and the sudden reduction of pressure cause rapid evaporation of the remaining moisture, so that quick setting is obtained. At first the stones or pebbles bound off, but when a layer of one-half an inch or more has been deposited they imbed themselves and further tamp the work, making it adhere strongly to brick, stone, reinforcing steel or old concrete. A thin slab made in this way has an almost metallic ring and is waterproof at heavy pressure. When the proper amount of water is used

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*Paper presented at the Eleventh Annual Convention of the American Concrete Institute.

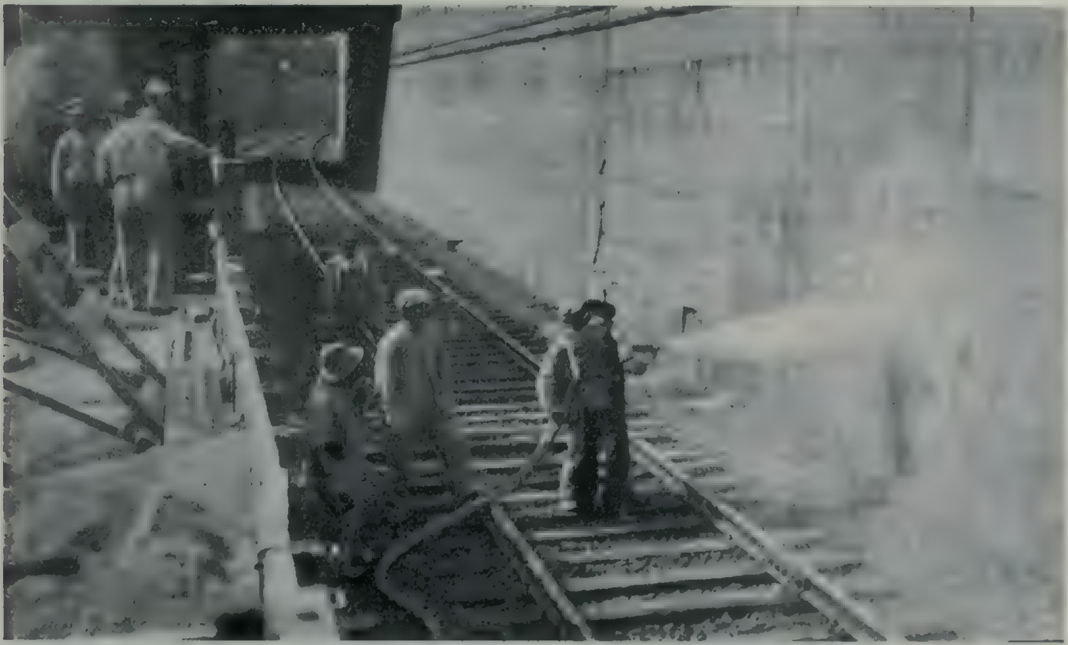


Fig. 3.—Concrete Atomizer operated with steam on the Lackawanna Railroad.

very little concrete falls away, and layers over one foot thick have been placed at one time on vertical walls. More water is used in the final coat, which is thus made plastic enough for easy finishing. During each period of mixing a stream of super-heated steam is kept flowing at low pressure through the outlet to keep the hose and the destination of the new work warm and moist. With careful handling excellent work can be done in freezing weather.

Fig. 1 shows one of the many holes in a concrete retaining wall on the Lackawanna Railway in Newark, N.J., where the deepest portion was 15 inches.

Fig. 2 shows the same place before screeding; this was filled in a single operation.

Fig. 3 shows the jet in operation filling an adjoining hole, while the deep place just mentioned appears in the lower right corner. It can be seen that very little material has been wasted, for the ballast next to the wall has but little covering, consisting of a small amount of sand and a few pebbles. These can be gathered up and used.

Fig. 4 is another view of the same work, showing the manner in which the steam was obtained from the locomotive of a work train. The picture shows

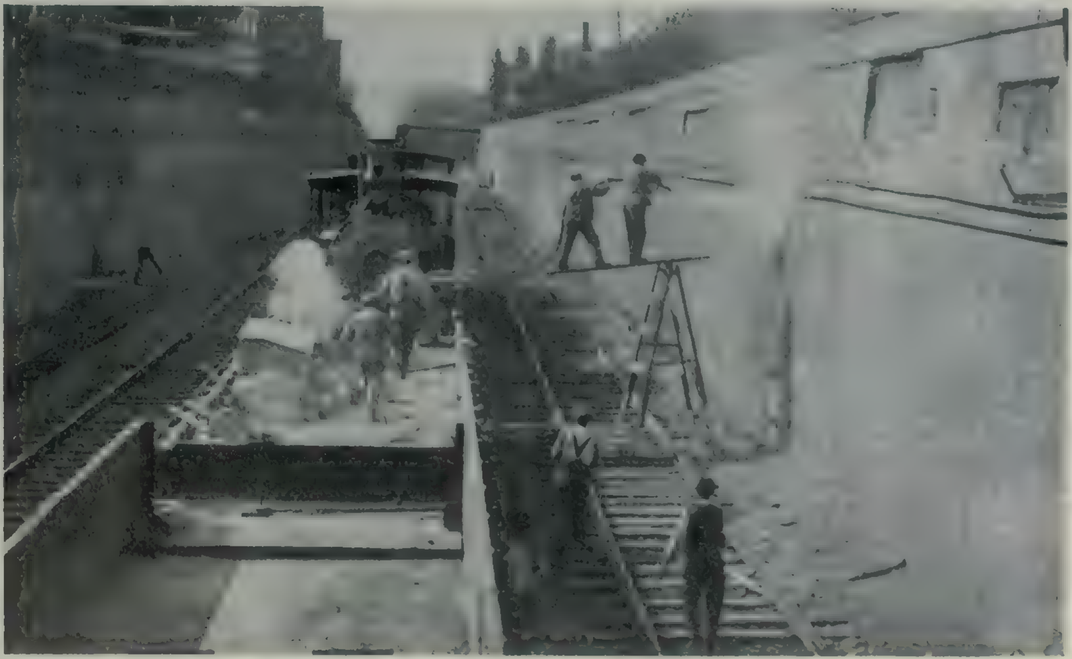


Fig. 4.- Jetting concrete with steam on the Lackawanna Railroad.

two men at the nozzle, but the duty of the extra man was merely to keep an eye on the watchman who announced the approach of trains.

Fig. 5 shows the machine used on the work. For want of a better name I have called it the Concrete Atomizer. This was rented for several months by the Lackawanna Railway and used in repairing defective and honeycombed work subject to tide-water at their Hoboken Terminal. Here compressed air was used, but in the repair work along the road, steam was taken direct from the locomotive, thus saving the trouble and great expense of the cumbersome air compressor with its motor, receiver, regulator, water pump and tank. The operation of this Atomizer was so satisfactory and its product of such high character that the Engineer in charge has written a most unusual and appreciative letter on the subject, and in accordance with his advice the road has recently purchased the apparatus for further extensive repairs and construction work.

One of my early experimental machines was used about two years ago on the New York Central, and over 6,000 square feet of structural steel was covered with from 2 to 6 inches of concrete, applied with compressed air and with steam. All of this work has proved as hard as flint and not a single crack or fault has developed in it. This is true of all the work of my other larger machines.

When the Atomizer was operated with air at another plant, a 60 h.p. boiler was used to supply steam for the compressor, and it consumed about 400 lbs. of No. 3 buckwheat coal per hour, using forced draught and producing about one cubic foot of concrete per minute. When steam was used direct instead of air, the same amount of work was done with natural draught and less than 100 lbs. of coal per hour used. The cost of the fuel for mixing, curing and placing one cubic yard of concrete with this little machine did not exceed ten cents, and a boiler of 30 h.p. would have been large enough for it.

When steam is used the mixing is done at a pressure of 75 to 80 lbs. with sufficient superheat to prevent condensation, thus maintaining the proper amount of water in the concrete. By increasing the amount of superheat to the proper degree, the steam issuing from the nozzle is kept in gaseous form so that the work deposited can easily be seen by the operator. The superheater can be located in the stack of the boiler if the work is nearby, or over a salamander if distant. Or when the boiler is operated at 180 to 200 lbs. pressure, a reducing valve is placed close to the machine and set for 85 lbs. pressure supply to the mixer, thus obtaining the required superheat. While experimenting with the superheater some interesting results were obtained with a lot of rejected cement whose neat briquets were like chalk. Many samples were mixed and the pressure and temperature increased. A point was at last reached when solid concrete was produced.

A special grade of rubber is used for the hose lining, and this is worn but very slightly by the concrete, since wet cement to quite an extent lubricates the surface. I have many feet of hose which is still in good condition after severe service for more than a year; and it shows very little wear. Special couplings are used with no metal parts exposed to the concrete stream.

To avoid delay through clogging of the hose, an expansible rubber nozzle is used whose size of opening is controlled by a lever in the hand of the operator. In case a pebble blocks the flow, a slight movement of the lever opens the passage to the full diameter of the hose and the obstruction is blown out. The pressure at the nozzle is about 45 lbs. and the stream of mingled vapor and concrete shields the operator from rebounding pebbles, while wooden ferrules on the nozzle levers protect his hands from the heat of the steam. A skilful operator can apply a thin, even layer of concrete almost as smooth as the cratch finish on plaster, or he can produce a surface lightly or heavily pebbled as may be desired. A glass finish can be given to the work by projecting it against an oiled sheet of planished metal.

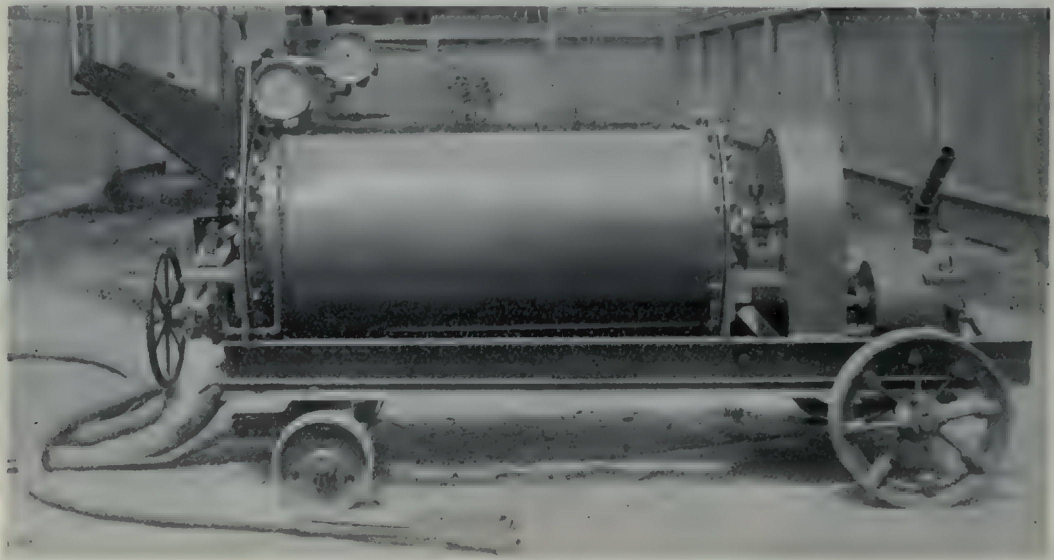


Fig. 5.—No. 2 Concrete Atomizer used on the Lackawanna Railroad.

The No. 2 Concrete Atomizer has a charging door either at one end or in a dome on the top. The driving shaft is square in section and carries a series of mixing paddles and scraping devices for keeping the surfaces clear. Ample clearance is given between the paddles and shell so that stones up to ¾ inch size can be used. In operation the rapid motion of the rotating parts keeps the air filled with flying particles of concrete. These particles are driven through the outlet valve and discharged into the hose, which is 1¾ inches inside diameter. The speed of the engine automatically increases as the load grows less, so that the rate of discharge can be kept uniform. When the cylinder is nearly empty the tank pressure falls and its steam supply is shut off; the rest of the work is done by the expansion of the steam through the hose. The piston of the outlet valve is made to clear all material from its path when closing so that no dead passages are left in which concrete can set and block the pipes.

The No. 3 Concrete Atomizer is similar in construction and has a mixing tank 5 feet long and 3 feet inside diameter. It is designed to mix about 20 cubic feet of loose materials with an output of 150 to 180 cubic feet per hour; it will handle one-inch stones. An engine of my own design is used with this machine, as the requirements of the service are unusual. The engine has a splash lubrication and is self-contained and powerful. It can be operated with compressed air when the machine is to be worked in tunnels or caissons where steam cannot be used. Even in this case the air can be superheated, if necessary, and the advantages of combined heat and pressure can be secured.

A prominent engineer is at present making careful records of the costs of curing and placing large masses of concrete with this machine and his report will in due time be submitted, with full details of the tensile and crushing strength of the product. It must be remembered that the only additional cost of the product beyond the cost of ordinary power mixing, is the fuel required to heat the materials to about 350 degrees Fahrenheit and to convey the concrete through the hose to its place in the work. Operating with steam, the cost of fuel and labor in mixing, treating and placing concrete with the small machine has been less than 80 cents per cubic yard. With the larger machine the cost will be about 50 cents. It is often objected that the 15 to 20 per cent. greater density obtained by the process causes a correspondingly greater cost per cubic foot for materials. This is true, but as the strength of the product is multiplied by 2½ to 3, the section can be reduced at least 25 per cent. and the cost of materials put on the same basis as ordinary work with a greatly increased factor of safety. The same result can be obtained by using less cement in the mix. The Concrete Atomizer can be used to replace the ordinary mixer, engine, hoisting apparatus, tower, chutes and runways in all kinds of light construction.

The process opens up many new fields for the use of cement. The adhesion is so great that old cobblestone or granite block pavements can at low cost be re-surfaced with a thin layer of dense, flinty concrete. The same treatment can be applied to worn-out macadam roads with good foundations. Earth irrigation ditches and canals can be strengthened and waterproofed. Frame buildings can be fireproofed by a thin self-supporting wall of reinforced concrete which can also take the weight of a light concrete roof. Slabs of concrete one inch thick with outer surfaces as smooth as planished steel can be easily made and used for forms in place of wood, becoming the outer part of the finished work, after the pouring is completed. This will reduce the cost of forms in certain classes of work. By the use of light reinforcement and thin removable metal sheets, hollow concrete house walls and floors can be quickly jetted into place at a lower cost than any other permanent construction. Such a building would be proof against fire, water, heat and cold and would greatly reduce the cost of living.

I believe that I have set before you the crude outlines of an entirely new structural art which will overcome all the present faults and disadvantages of concrete. I feel that you will soon become convinced that in making perfect concrete, heat and pressure are as necessary as in the manufacture of perfect brick.

Pile Pulling Methods Compared

A gallows frame, with a derrick luffed to the heavy pulley tackle, is looked upon by many contractors as the best means of pulling piles under ordinary circumstances; nevertheless, piles are sometimes pulled with a lever, and with a gin-pole, says a writer in The Engineering Record, in describing some interesting work. At first sight the lever method would appear the best, as with a moderate size lever and a 5-ton derrick, where there is a good "heel" close to the line of sheeting, a pull of 80 tons can be readily developed. To pull 80 tons with an ordinary hoist requires at least sixteen parts of line, and a heavy frame or gin-pole. As a matter of actual fact, a pull of 40 tons, possible with eight parts of line with a frame made of 12 x 12-in. timber, will draw out a sheet pile which cannot be budged with a lever of double the power. The reason is that the frame can be spotted to pull in direct line with the sheet pile, while the lever cannot. The blocking slips, or the lever in rising changes slightly in line of pull. Besides, it is difficult to adjust a hitch from the lever to the pile which will not throw undue strain on some one part, and breakdowns are constant. Then, too, the lever is more cumbersome to handle than a gin-pole or gallows-frame.

A gallows frame is to be preferred to a gin-pole for this service. It is much stronger than a gin-pole, and is more easily set up, as it need be guyed normal to one plane only, while a gin-pole must be guyed in all directions. A short gallows frame was used for pulling steel sheeting on a St. Louis well foundation job which had braced sills under the posts, and required no guys. Where there is a place to set such a machine up it will pull piles faster than any other rig.

The riggers who advocate the gin-pole claim a longer pull without changing the hitch on the pile, as a gin-pole can be conveniently made taller than a frame. This is often a disadvantage, however, as when it comes time to drop the hitch, the hitch is inaccessible without considerable climbing, as it has been pulled up out of reach; and hitches will not always shake loose and slide down the pile as they should. As a matter of fact, the heavy pulling hitch need only be used for the first 10 ft., after which the derrick can pull the piles directly.

In reeving up the heavy falls for pulling long sheet piles, four to six sheave blocks should be used, depending on the power of the derrick. These blocks should always be rove from the centre—that is, the lead line should enter the lower block on one of the centre sheaves. If the blocks are rove in the ordinary way, the tilt of the blocks under strain, and consequent friction loss in the rope, takes all the strain out of the standing part and the parts next to it. This loads the blocks eccentrically, and will tear the lower blocks to pieces, if it is of ordinary construction, before three piles have been pulled.

The ends of reinforcing bars which are left protruding for splicing should be, if they are not likely to be connected up for some time, painted with some paint to diminish rusting and to guard against being bent or loosened.

The Manufacture of Shells—A New Industry Which the War has Given Canada

NO small importance attaches to the new industry which has been established in Canada since the outbreak of the war—namely, the manufacturing of shells. During the last few months some one hundred and fifty contracts, running into millions of dollars, have been divided among Canadian firms, the contracts having been placed by a Government body known as the Dominion Shell Committee.

The extent to which the requirements have been spread over the Canadian industry may be gathered from the fact that among the various orders placed contracts have been received by the Northern Electric Company for tin cups, brass tubes and lead bullets; by the Thomas Davidson Company, for lead bullets, brass sockets and brass caps; by the Galt Machine Screw Company, for brass tubes and grub screws; by the John Morrow Screw and Machine Company, for brass tubes, brass sockets and brass cops; by the Canadian Seamless Wire Company, for brass tubes; by the Canada Metal Company, for lead bullets; by the Canada Forge Company, for shell forgings; by the Canadian Billings and Spencer Company, for steel discs; by the Chadwick Brass Company, for sockets and caps; by the Nova Scotia Steel and Coal Company, for forgings, plugs and sockets; by the Sheet Metal Products Company, for tin cups; by the Empire Manufacturing Company, for sockets and plugs; by the Hamilton Steel Company, the Canadian Westinghouse Company, and the Thomas Robertson Company, for bands; and by Messrs. Firstbrook Bros., Limited, for shell packing cases.

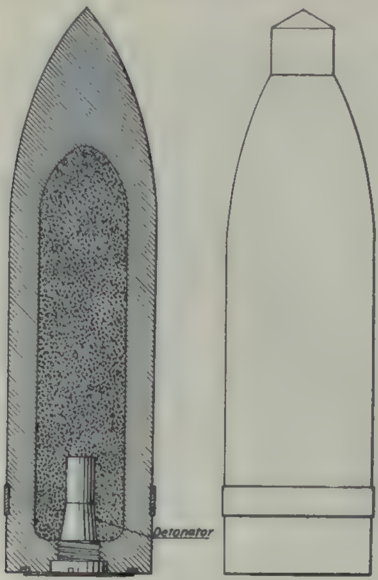


Fig. 1.—The simplest form of explosive projectiles

M. L. Smith, B. A.Sc., writing in our Toronto contemporary, Canadian Machinery (to whom we are indebted for the accompanying article and illustrations), observes that the placing of these contracts means much both for our industrial welfare and our Empire patriotism.

Projectiles, commonly known as shells, have a number of different purposes and vary widely in construction. In Fig. 1 is shown a simple and much-used form of explosive projectile. The explosive charge is seen encased in the solid steel of the shell and is provided with a detonator at the rear end which is intended to explode the charge upon impact or immediately afterwards. The left half of the figure represents a projectile designed for the destruction of fortresses, earthworks, etc., where high explosive power is required. When required to pierce hardened steel armour, this shell is provided with a covering of softer metal over the hardened point. Otherwise the shell would simply shatter itself without perforating the hardened protective surface.

Shrapnel Shells

For the destruction of men and other animate objects, the type of projectiles known as shrapnel are employed. Two typical shrapnel projectiles are shown in Fig. 2, and their operaton is as follows. The nose or time-fuse can be adjusted to explode the shell at any predetermined time after its discharge from the gun, and an effort is made to have the shell explode about a hundred yards in front of the enemy and directly above him. The case is made of a high grade of steel and is not itself shattered.

The flame from the time-fuse explodes the powder in the central tube and the rear end of the shell. This simply blows the fuse-end off and discharges the whole load of bullets straight ahead as if shot from an enormous shotgun. The explosive charge is not large in comparison to the weight of metal discharged, but, as the projectile as a whole has a very considerable initial velocity, each bullet will have sufficient energy to administer a disabling wound at 100 yards, and bullets enough are provided to furnish one for every square yard of surface attacked.

Timing Arrangements

Shells are timed both by clockwork and by a time-fuse. A typical example of the latter is shown in Fig. 3. Upon discharge from the gun the inertia of the percussion plunger P causes it to shear off the firing pin A which explodes the primer charge J. The flame from this passes through the hole B and ignites the fixed time-train C. This fixed time-train burns around until it comes to the hole E, through which the flame can pass to the movable time-train at its lower end. The movable time-train burns back until the hole D is reached through which the flame obtains access to the powder G which forms part of the bursting charge of the shell.

It is easily seen that, by rotating the movable ring M so that the holes E and D become further separated around the circumference of the shell, the time required for the train C to burn around to the hole E and back along the movable train to the hole D is increased. The time allowed, of course, depends upon the distance the shell has to travel from the gun to the point here it is desired to discharge the bullets, and if the holes E and D be placed directly in line, the shell will explode but a few feet from the muzzle of the gun.

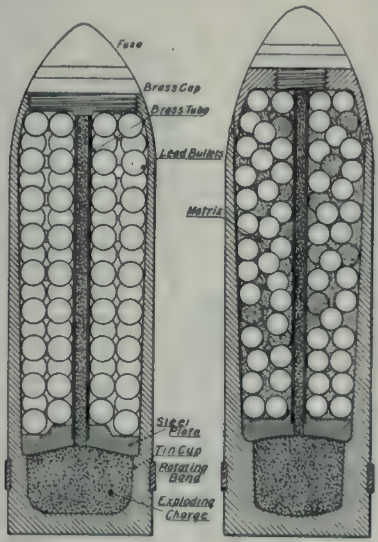
The time-train rings do not form complete circles, so that for transportation, or if it be not desired to use the time fuse, the hole E is set opposite the blank part of the time train C. In case the shell fails to explode through the agency of the time-fuse, it will explode upon impact. Upon firing, the percussion ring H slips back over the plunger which carries the firing-pin K. Upon impact of the shell with some solid object, the whole flies forward, the pin K exploding the primer charge T. This instantly ignites the exploding charge G through the tube O.

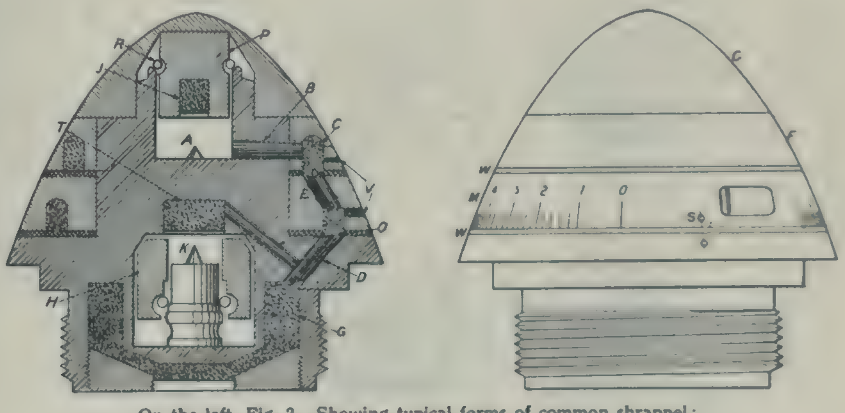
The Explosive

The explosive used in all kinds of shells is, in nearly all cases, a high grade of black powder. Few of the higher explosives are suitable for this purpose. Any of the compounds of nitro-glycerine or other explosives which are liable to detonate by shock are manifestly unsuitable. Many deteriorate in long storage, and acids will react with the metal wolls of the projectile. Picric acid or its salts, alone or in combination with other substances intended to make it less sensitive to detonation, are much used in the form of the Japanese shimose and the British lyddite. Great care must be exercised with these, however, to prevent the explosive coming in contact with the metal surface of the shell.

The Canadian-Made Article

In Fig. 2, the left-hand figure represents a typical 18-pound British shrapnel shell such as, along with 15-pounders, are, at present, being made in large quantities in Canadian factories. The body is forged by hydraulic pressure from a solid billet of high grade steel, and the machining represents two simple series of operations on turret lathes. After the finishing of the machine work and inspection, the cases are subjected to a heat treatment and oil quenching.





On the left, Fig. 2.—Showing typical forms of common shrapnel; on the right, Fig. 3.—Details of adjustable time-fuse.

The brass cap which screws into the steel body and carries the fuse is turned from the rough casting in four turret lathe operations and is fitted with a brass plug for the purpose of protecting the thread until the fuse, which is made at the Government Arsenals, is to be screwed in place. The fuse is kept from becoming loose and screwing out by means of small grub screws.

The central pipe carrying part of the explosive charge is of drawn brass tubing cut to length; shouldered and threaded to screw into the steel plate at its lower end, and is soldered into the brass cap at the top. The powder is contained in a tin cup which is formed accurately to fit the inside of the base of the shell. This means simple press and soldering operations. The bullets, which are about one-half inch in diameter, and of which 364 are required for each shell, are made of a mixture of lead and antimony and are formed cold in dies under presses. The copper rotating bands are rolled to size and are fastened in place by means of a closing press for the purpose. The interstices between the bullets are filled with a matrix composed of certain forms of pitch or other inflammable substances designed to protect the bullets from deformation when the shell is being discharged from the gun, and to indicate by its smoke the exact point where the explosion of the shell takes place.

A novel method of expediting building construction during winter weather was employed at Cleveland a month or so ago, when in seventeen days a brick-wall building 90 ft. x 202 ft. in plan, one-storey high, with two monitors, was erected under the shelter of a tent, 100 ft. x 350 ft., with 10-ft. side walls. Excavating for the foundations commenced on January 10th, and on January 27th the building was turned over to its owners, with the masonry work guaranteed against the effects of freezing. The contractor paid $1,000 for the use of the tent for thirty days, the tent company putting the tent up, raising it several feet after the first stage of the work, and removing it, besides carrying the risk of damage. Carpenters and other mechanics were provided with a workshop underneath the tent. Heating was effected by steam brought from the power plant, the heating pipes being placed along the inside of the walls of the building and through its centre. During part of the time of construction, the weather ranged from 0 to 10 deg. F.

The market for sewage sludge as a fertilizer has been greatly curtailed since the outbreak of the war in Europe. According to the London "Engineer," the war has deprived some English producers of their accustomed profits from the sale of this material in northern France, where large quantities of treated sludge formerly were utilized.

Mr. A. R. Mosher, associated with Messrs. J. S. Miller and David Ferguson in the invention of a concrete railway tie and rail base, has just received notice that the British patents applied for have been granted. The tie is already patented in Canada and the United States. Application has been made in several other countries for patent rights.

Notice has been given of a Bill (by the Minister of Justice) to give the railway companies an extension of one year in which to complete their lines, owing to the halting of construction work caused by the war.

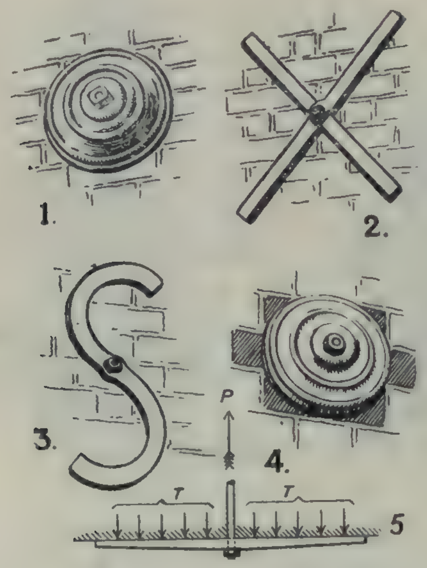
Tie-Rods and Wall-Anchors for Buildings on Weak Foundations

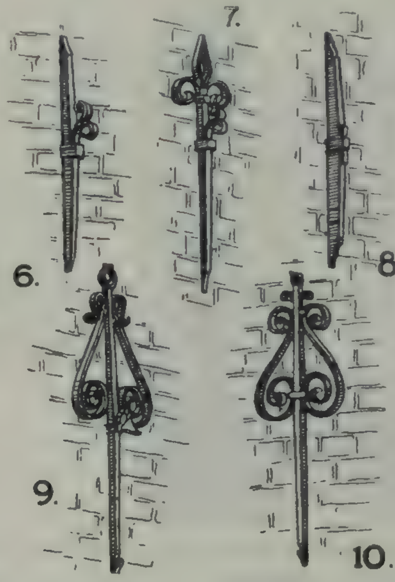
(From the Building News, London, Eng.)

In London and many other towns built on alluvial soil, it is no uncommon thing to find old buildings whose bulging walls have been saved from collapse by means of wrought-iron tie-rods judiciously inserted at the upper floor levels. Frequently this method of securing dilapidated walls is not only expeditious, but economical, whilst many buildings, otherwise unsafe, have their useful term of life greatly prolonged.

The tie-rods, generally ¾-in. or 1-in. diameter, screwed at each end, are inserted at right angles to the bulging or overhanging wall. They are placed for preference under piers, and not under or over window openings, a good position being some 19 ins. or so from the quoin angles, if the building is detached. Where the floor-joists run parallel to the rods, there is no difficulty in getting the latter through, the walls being simply pierced where necessary by means of the bricklayer's chisel. Where the rods have to cross floor-joists, the latter should be notched as slightly as possible, and, preferably, near to the supports, so that they may not be weakened more than is aboslutely necessary. When inserted, the rods will then be almost in contact with the under side of the floorboards. At each end of the tie-rod, as near as may be to the bulged or overhanging part of the wall, a bearing-plate or "wall-anchor" must be placed.

The forms usually met with in the London district are either:—(1) A circular cast-iron plate from 9 ins. to 12 ins. diameter, and about 1½ins. thick at centre. (2) Two wrought-iron bars about 2 ins. by ⅜-in., or 3 ins. by ½ in., placed in the form of a St. Andrew's Cross; or (3) A wrought-iron bar of similar dimensions, forged into the shape of the letter S, to indicate, as once suggested by an unprofessional friend, that the building so treated is "safe." Whichever form is selected, a hole is prepared at its centre of figure, through which the screwed end of the tie-rod is passed, and a square nut enables the plate to be closely clamped to the wall. Usually the plate is not bedded on mortar; but it is suggested that, after tightening up, a neat pointing of Portland cement between the plate and the brickwork would not only insure more perfect contact and bearing, but would also help to prevent corrosion of the ironwork where it cannot be got at for repainting. The objection urged against the method here described is that these plates disfigure any building to which they are applied, and it is generally understood that they detract from the market value of property which exhibits them; not merely because of the impaired appearance (many of these buildings never were noted for their appearance), but on account of the indication that the main walls have settled, and therefore, presumably, may be liable to further movement.





It must be admitted that the design of these plates leaves much to be desired from both the scientific and the artistic standpoints. Taking the common type of cast-iron plate, which exhibits a nauseating repetition of most commonplace design, its chief structural fault is that it has far too little grip of the brickwork. In the worst case, a 9-in. plate will not more than cover three courses of bricks, including two stretchers and two headers, the centre header being cut away for the tie-rod. (Fig. 4.) This gives a perimeter of 2 ft. 3 ins. only, upon which frictional resistance to slipping through of the bricks can be expected; for in bad brickwork the perpend joints are often nearly devoid of mortar. Owing to the fact that in ordinary bonding these joints generally run directly through the wall, whatever its thickness may be, it will be seen that the block of brickwork grasped by the plate might be pulled inwards, without giving much support to the surrounding work. This is especially liable to happen in old and dilapidated walls, where the mortar, originally of poor quality, has largely perished through age and weathering. The same fault is observable in the larger cast-iron plates, which never grip more than four or five courses of bricks. The only departure one recalls from the ordinary circular casting is a five-lobed design, somewhat resembling a stiffly-conventional Tudor rose with angular petals; but only five courses of brick were grasped.

Turning now to wrought-iron specimens, it will be seen that if they are assumed to bear evenly upon the face of the wall, the pull of the tie-rod when screwed up will throw them into a state of stress similar to that of a double cantilever (see Fig. 5), which is exemplified in the case of a concrete foundation supporting a column or stanchion; except that in lieu of the vertical pressure of the column, we have the horizontal pull, P, of the tie, whilst the vertical reaction of the earth is replaced by the horizontal outward thrust, T, of the wall, the pull and outward thrust being equal and opposite. An elementary knowledge of Mechanics will enable us correctly to design such a beam. An economical and efficient design will be deeper than it is broad, and from a maximum depth at the centre of its length, it will taper towards each end. Its depth will be at right angles to the face of the wall. Comparing theoretical considerations with the examples provided by our modern smiths, we usually find all first principles ignored. The bar is placed flat against the wall instead of edgewise, thus giving the minimum resistance to bending, and allowing its extremities to spring away from their work. The bar is usually of the same width and thickness throughout—a wasteful misuse of metal, which also gives the bar a clumsy and unfinished appearance. Moreover, just where the greatest bending stress occurs, the bar is weakened by unskilful forging, or by the total omission of forging around the hole required for the tie-rod. The utter lack of artistic merit exhibited by these wall-plates is as much due to the radically defective design just described, as it is to an entire want of finish, and an absence of the least attempt to refine or ennoble their form by any of that enrichment to which wrought-iron lends itself so kindly under the hand of the sympathetic workman.

At this point it is refreshing to turn from these crude productions of our modern rolling-mills and smiths, to the admirable examples which meet one on every side in Flanders. A brief consideration of a few typical specimens will soon convince one of the keen scientific insight, as well as of the masterly artistic ability with which they were lovingly fashioned. Even the apparently superfluous scroll-work is made to serve a constructive purpose by giving the anchor an increased grasp of wall surface. However modest the forging, one invariably finds it has a good grasp of the brickwork. It is generally not less than 3 ft. long, embracing 12 or more courses of brick. Square in section, or deeper in the direction of the bending stress (as in Figs. 6 and 8), it is gently tapered off towards the ends with a refinement rivalling that of the entasis of a column. Nor is the craftsman content with this. He does not leave his work until he has embellished it with some little scroll or twist—perhaps a neat application of a simple moulding, or even a few chisel-marks struck decoratively. In fact, the builder was not ashamed of these ties and their adjuncts; rather did he delight in demonstrating that his building was well-knit together.

On the treacherous soil of the Netherlands, where piled foundations were often a necessity, it became highly desirable to so construct the building that, in the event of settlement, the lofty walls should be in no danger of falling. Hence we find that at every floor level, and often through gabled roofs as well, iron tie-rods were inserted when the building was erected, and the wall-anchors were eagerly seized upon as opportunities for the display of ornament. A first visit to Belgium or Holland will be a revelation to many. The old smiths simply revelled in the design of these anchors. Their variety is endless. Initial letters, monograms, ciphers, and other symbolical devices are common, whilst foliage and flowers were tastefully introduced in the best examples. Buildings are often dated by anchors, fashioned into figures denoting the year of their erection. It is recorded that sixty-eight different sets were found in Ypres alone about the middle of the last century. Their design is always appropriate and interesting, the workmanship masterly, and often exquisite. From the 15th to the 18th centuries the use of these tie-rods and wall-anchors seems to have been quite general in all kinds of brick buildings in Flanders. One sees them on the world-famed town halls and belfries, as well as on the fronts of the humble street-dwellings along the canals. Their use is even continued to the present day in buildings of considerable pretensions, and one finds, as a consequence, that the walls are far less liable to get into a cracked and dangerous state than are walls of buildings erected with ties.

Previous to the last century, screwed bolts and screw-threads were practically unknown in constructive work, the necessary tackle for cutting the threads being then beyond the outfit of an ordinary smith. Hence we find that where tightening up had to be done, some arrangement of keys, or cotters, was employed. In wall-ties, therefore, the ends were forged with suitable sockets, outside the walls, and through these the wall-anchors were passed, all tightening being done either by small keys driven into the sockets (as in Fig. 8), or by a cottered joint in the tie within the building. Even these necessary keys and sockets were made to serve an ornamental purpose in the design.

Wide Scope for Further Use

Without merely copying these fine old Flemish wall-anchors, there is still a wide scope for an intelligent and legitimate use of wall-ties in modern buildings erected upon unstable foundations. For instance, it is well known that upon soils such as our London clay, especially where it occurs on a hillside, it is necessary to excavate to considerable depths, and to employ heavy concrete foundations for the most commonplace buildings, if the owner is to be protected against all risk of settlement. For a sum representing but a fraction of the cost of such foundations it would be possible securely to tie the walls at floor levels in such a way that the otherwise expensive foundation work might be considerably curtailed. With good design and the use of modern materials the wall-anchors might be rendered no less decorative than the wrought-iron work frequently seen suspending the canopies over entrance doors of suburban villas.

If wall-anchors are considered inconsistent with the design of the building, or for other reasons are thought undesirable, it is still possible to attain the same end by a well-considered employment of hoop-iron band. The hoop-iron, if well embedded in a Portland cement mortar joint, will be effectually protected from rusting, and by bending it over at right-angles, all quoins may be reinforced, the cross and party-walls being tied to external walls by suitable strips of hoop-iron hooked over the running lengths in the latter.

In place of unsightly nuts screwed to the ends of projecting tie-rods, it would be possible to employ ornamental forged heads, any necessary tightening up being done by means of right and left-handed screw shackle-joints on the rods within the building. In cases, however, where tie-rods are inserted whilst the building is being erected, very little tightening up is required; in fact, on the Continent the rods are sometimes merely bolted or otherwise secured to the wood framing of the floors, without being passed right through the building.

Were an apology needed for the use of iron ties, ample authority could be found in some of the finest buildings of the Middle Ages, as well as in Renaissance architecture. The iron ties in the choir arcade of Westminster Abbey and at Peterborough Cathedral are well-known examples, whilst it has been said that when first erected, Salisbury Cathedral tower was the finest piece of blacksmithing in Europe, bound together as it is at various stages with bands of ironwork, both within and without the masonry. Nor did Sir Christopher Wren consider it unworkmanlike to employ quantities of ironwork in chains, ties, and cramps, it being stated on excellent authority that St. Paul's Cathedral is literally laced together with iron. When it is remembered that many of our finest cathedrals stand on alluvial soil, and that when they were erected the builders had neither the knowledge nor the means at their disposal for putting in adequate foundations on such soils, it will be seen that the judicious use of iron ties gave them a ready and simple means of making their buildings secure.

Finally, as a simple and effective method of dealing with bulged and leaning walls, especially in the case of ancient buildings which it is desired to preserve, as far as possible, in their original state, a few well-placed tie-rods, with suitable wall-anchors, will often obviate the necessity for demolition and rebuilding. Instead of the modern English plan of employing flat bar-iron for these latter, a specially-designed forging would be not only more efficient, but more artistically effective. Calculation shows that rolled channels, 2½ in. by 1 in., placed flat against the wall, would be four times as strong as 2 in. by ⅜ in. flat bar, and about ten times as stiff to resist bending; whilst their sectional area, and, therefore, their cost, per foot run, would be merely some 60 per cent. greater. They would also lend themselves to effective ornamental treatment if their flanges were cut off towards the ends, the flat web being split, opened, and fish-tailed, or scrolled, according to the fancy of the designer.

Efficiency in Cleaning Filters

INCREASED efficiency of 15 per cent., with a larger output of work, can be obtained by laying out the work early in the season and following it up systematically, according to Mr. Sanford E. Thompson, who discussed the methods of cleaning filters at Philadelphia in an interesting paper before the American Society of Mechanical Engineers. Mr. Thompson is in favor of putting municipal work on a basis which gives each man a well-defined task to do in a given time, with a definite reward for its accomplishment. It is pointed out that in Chicago the employees in each municipal department are definitely graded, with different wages for each grade, by which system it is possible to reward a man according to his ability. The Philadelphia ordinances prevent the payment of a bonus, and this, according to the author of the paper, has made it difficult to improve the service.

The particular operation studied was the removing and cleaning of filter sand, which operation is in charge of Carleton E. Davis, chief of the Bureau of Water. The city has five large filtration plants consisting of covered reservoirs operated by slow sand filtration.

In the filtration plant first handled by the method recommended by Mr. Thompson, there are sixty-five filters which are cleaned by about 128 men. Each filter is about 140 feet wide by 250 feet long and is built with groined arch bottom and roof, the supporting columns being about 16 feet apart on centres. The Nichols method of washing is used in this plant, sand being shovelled into an ejector, carried by water to a separator and the clean sand returned by a hose to the bed, where it is properly distributed and levelled.

Four washing gangs are required for each filter bed, the outside gangs having two and a half bays each and the inside gangs having two bays to clean. In each gang there are three shovellers to a hopper, two men shovelling at a time while one rests. Each man shovels forty minutes and then rests twenty minutes. A fourth man takes care of the hose from the separator, distributing the clean sand to the bed. A fifth man, recently introduced, working with two gangs, spades up the hard sand that has been uncovered before the replacing of the washed sand.

The object was to lay out the work of each gang so as to increase the effectiveness of the plant and provide a definite task to be accomplished in a day. The results of the plan which is being put into operation are as follows:

Rotation of cleaning the filters is planned in advance by well defined rule.

A definite area of sand to clean is assigned to each gang, this area depending upon the depth of cleaning necessary.

This setting of tasks has increased the output of each gang 15 per cent., and this should be further increased to at least 25 per cent.

Accurate records are kept showing the time consumed by each gang.

Cost accounts, as well as payroll, are made up from the time tickets furnished to the men.

Gang leaders are required to pay closer attention to their duties.

Improved apparatus and machinery are under consideration.

Methods of determining depths of sand to clean are being standardized.

At the beginning, studies were made of the men and methods employed to see whether the manner of handling the work could be improved. Time studies were made to determine the unit times for each individual operation, so that the tasks could be figured accurately in advance.

Time studies were made, by the aid of a stop watch, of the labor operation in the beds, such as shovelling dirty sand to hopper, cleaning up around hopper, moving hopper, moving separator and moving track. These times for individual operations were then converted for direct use into the time per cubic yard for one inch of depth. It was found that moving the hopper required a unit time of 0.2 of a minute, moving separator 0.5 of a minute, moving hopper hose .25 of a minute, moving track, .83 of a minute, waiting for hopper to empty .42 minute, moving pressure hose 1.8 minutes, shovelling to hopper 6.32 minutes per cubic yard per one inch depth, and additional necessary rest .12 minute per cubic yard. Having determined the unit times, the area of surface that should be shovelled by each gang was figured and the point to which they were supposed to go in a day's work was marked with a flag. (In order to fix this it is necessary to determine in advance by test holes the depth which should be cleaned.) Curves have been plotted giving distances a gang should cover for each depth of cleaning. Calculations of the area the gang should shovel were made without informing the gang, and for two days the amount covered by each gang was from 10.5 to 31.5 per cent. less than this. A task was then set for one gang, and they readily accomplished this task; after which a daily task was set for each of the gangs.

After this new method had been employed for some time, it was compared with the old by taking an average of twenty-seven cleanings at random from a period of one and a half years. These showed an average rate of 6.3 cubic yards shovelled per day per gang. An average of fifty-five cleanings after task work was started gave 7.2 cubic yards, an increase of nearly 15 per cent. The figured rate, however, was 8.4 cubic yards, or more than double this increase, and it is believed that this could be reached with first-class supervision; and that 50 per cent. increase could be obtained if it were possible to pay a money bonus. A plan considered as a partial incentive is to keep a record card for each man, showing his output and thus indicating his relative rank as a worker, which rank would influence his retention when work was slack, or his promotion to a higher position.

The studies indicated a number of changes desirable in the apparatus and methods of handling it. It was found that the lines of piping for the water used in the cleaning operation were poorly arranged, requiring too long lengths of hose in certain cases; while in other cases pipe lines had to be moved from bed to bed during cleaning. It has also been shown that a mechanical washing contrivance probably can be devised which will reduce the cost of cleaning. It was also found that the hoppers and separators were of such size that they would not handle just the amount which the gang could readily shovel; the hopper, for instance, having an output slightly greater than could be shovelled into it by one man, but not nearly as much as could be shovelled by two.

A saving of 45 per cent was effected in repairs to asphalt paving by the city of Niagara Falls, N.Y., last year by the installation of a municipal repair plant. The report of the city engineer shows that during the year 36.673 sq. yds. of pavement were repaired at a cost of $29,144.39. If this work had been done at the contractor's price of $1.34 per square yard, which the city previously paid, the total cost of the work would have been $63,161.94.

The method of coating concrete surfaces with ordinary linseed oil until it ceases to be absorbed is sometimes used. There are two difficulties encountered in using an oil of this nature in concrete: First, linseed oil is an unstable compound and does not have a very long life; again, the oil coming in contact with the cement produces a soap which is soluble in water and is soon washed off.

Temporary Troughs for Trenching

In excavating trenches in Vancouver, B.C., when small sewers are being replaced or for any other reason are temporarily out of service, troughs of canvas are used for carrying the sewage meantime. Wooden troughs were formerly used there, as elsewhere, but the canvas ones are less expensive and interfere less with the work. They are made by fastening eyelets to both edges of a strip of canvas, opposite each other, and each pair of eyelets is then hung on a spike driven into the sheeting, the water flowing through the canvas trough keeping the canvas sufficiently swelled out to carry it. The spikes are of course driven so as to give the trough the desired grade or fall. Three hundred feet or more of such trough has been used. Laterals are carried across the trench to this trough by short canvas troughs suspended from cross braces.

Tripod of 3-inch Pipe Sets Arch Centres in Close Quarters

A travelling gin-pole consisting of a tripod of 3-in. steel pipe set on a four-wheel timber truck of 10-ft. gage was used to set arch centres in cramped quarters on a large section of the Fallsway viaduct in Baltimore. The work is described by a correspondent of The Engineering Record.

The truck was built like a turntable with an upper and lower frame 10 x 10 ft. in plan. Hoisting power was furnished by a hand crab. The three pipe legs rested on the outer timbers of the top frame and their footings, consisting in each case of two steel angle lugs between which the flattened end of the pipe leg was inserted and made fast by a horizontal pin. At the head of the tripod, each pipe-end was also flattened and a pin run through the three for the connection. Thus, in erecting or dismantling, every joint was a hinge. Flat steel ties fastened to the legs about half way up by removable clamps were used to stiffen the structure. A single-line block and fall was used to handle the timber centering trusses. These trusses were 54 to 57 ft. span, and weighed about 2 tons each. The maximum lift was about 25 ft. Eighteen trusses were used to support the forms for each arch span.

In the portion of the viaduct which crosses the railroad yard, there was no opportunity to use a locomotive crane to move these centres from one span to the next. This traveller was designed to operate under these conditions as follows. A light track for the traveller was laid perpendicular to the roadway under the centre of one span. The centres were then dropped from the preceding spans, dragged forward within reach of the traveller, and set in place by it as it backed from one side of the viaduct to the other. The turntable feature of the traveller gave the necessary lateral movement for setting the trusses in correct position without the use of outhaul tackle. While this arch was being poured, a small crew dismantled the traveller and set it up again under the next arch.

Concrete curb constructed as an integral part of the pavement is being used in some places, and is said to effect a saving in cost, while it avoids any longitudinal joint between curb, gutter and paving. It is essential that the transverse joints in the pavement should extend through the curb. In one case where the asphaltic felt used as a joint filler did not always extend to the rear face of the curb, the face of the curb cracked from expansion and was broken off for a distance of 4 to 6 ins. on each side of the expansion joint. The low curb adapted for boulevard and parkway traffic can be constructed by using a strikeboard with ends conforming to the gutter curvature, no form being required for the inner face of the curb. For heavier traffic, a higher curb should be used. With this, the pavement is first struck off in the usual manner, then a board is clamped to the outer form to act as the form of the face of the curb, spacers holding it at the required distance and position. If reinforcement is used in the pavement, it should be bent upward into the curb space.

Plans are being considered for the formation of an organization of street cleaning officials of the United States and Canada. During the recent exhibition of apparatus held under the auspices of the New York Department of Street Cleaning, an informal conference considered the question and the following committee was appointed to examine into the desirability of creating a new street cleaning organization. The members of this committee are J. T. Fetherston, of New York, chairman; Richard T. Fox, of Chicago; G. Hanna, of Cleveland; Walter G. Leininger, of Chicago, and G. B. Wilson, of Toronto. This committee has sent out a circular letter to street cleaning officials throughout the United States and Canada asking their opinions as to the need of such an organization as is proposed

Granite block paving with close joints is the only satisfactory pavement for use between the rails of car tracks, says Henry Welles Durham, City Engineer of the Bureau of Highways of Manhattan, in his annual report, based on study of experience in all parts of the world. While such pavements laid under the rigid specifications now in force in Manhattan are expensive in first cost, the maintenance is far less than the older type of pavements which have to be constantly overhauled. The New York Railways Company has during the past year adopted the practice of using close-jointed granite-block paving in all its repair work.

Montreal Harbor Commissioners' Activities

MUCH of the annual report of the Montreal Harbour Commissioners, just issued, is descriptive of the visit paid by Mr. W. G. Ross (President), Mr. F. W. Cowie (Chief Engineer), and Mr. M. P. Fennell, Jr. (Assistant Secretary) to the principal European ports, with the object of studying developments before proceeding with a further general scheme of improvements at Montreal, made possible by a vote of $9,000,000 by the Government. The officials visited London, Havre, Marseilles, Genoa, Hamburg, Rotterdam, Antwerp, Bristol, Liverpool, Manchester, Glasgow, Edinburgh, Leith, Rosyth, Hull and Southampton. The report states that the things accomplished at these points are well worth a study by those who seek to make Montreal a great harbor. A glance at the accompanying statistical table of expenditure, in round figures, made at some of the leading ports will show the amount of harbor development necessary to meet modern shipping demands.

London	**$200,000,000**	**Rotterdam**	**$ 50,000,000**
Liverpool	**155,000,000**	**Bristol**	**40,000,000**
Hamburg	**115,000,000**	**Marseilles**	**40,000,000**
Manchester	**100,000,000**	**Havre**	**30,000,000**
Newcastle	**90,000,000**	**Southampton**	**30,000,000**
Antwerp	**60,000,000**	**Genoa, 1903-1911**	**25,000,000**
Glasgow	**50,000,000**	**Montreal**	**25,000,000**

A special feature noticed at British ports was the facilities provided for the care of perishable products from Canada. The expansion of Canadian trade, especially in the last five years, makes it imperative that the sea terminals of the country shall be further vigorously developed if Canadian business is to be handled by Canadians, otherwise Canadian trade will go by routes over which this country has no control. After describing the facilities at the various ports, the Commissioners sum the result of the visit in the following words: "The conclusions to be drawn as a result of the careful study of the causes of success of the different ports which were visited, are, in brief: that Montreal possesses all the features that make for the success of a great port and is being developed along proper lines. It possesses unity of control in its management, adequate room for enlargement, and a carefully prepared plan providing for expansion. When it is considered how important the possession of a great seaport is for the economic welfare of a nation, it is imperative that the harbor of Montreal should be developed so that it may not only care for the pressing needs of the present, but for the great and increasing business of which it is assured in the future. It may be fairly stated that no port in Europe and hardly any other in America has a more commanding position than Montreal, with respect not only to the trade of the Dominion but of the whole continent. Situated as it is at the interchange point of ocean and inland shipping and at the converging point of the three transcontinental railway systems, Montreal should be able, with proper terminal facilities, to compete on equal terms with any port for the trade of that vast territory which is tributary to the Great Lakes and their connecting waterways."

With regard to the work of the engineering department of the harbor, it is stated that the following works were carried out during the year: the improvement and extension of harbor railway tracks; the continuation of the new Victoria Pier and Market Basin; the continuation of construction of bulkhead High Level wharves on the river front, eastwards from Victoria Pier; general dredging for widening and deepening of basins and berths; dredging of channels for the amelioration of St. Mary's Current; paving and laying railway tracks on the wharves; the continuation, almost to completion, of improvements resulting in the floating dock basin and site for shipbuilding and repair yard; the construction and improvement of harbor facilities, such as hoists, flood gates, bridges, subways and freight yards; additions and improvements to Harbor Commissioners' construction plant; the construction of an industrial wharf at Pointe-aux-Trembles; the construction of addition to Grain Elevator No. 1; the construction of a new subway to the harbor at Aylwin Street; the construction of two transit sheds, Nos. 24 and 25; the maintenance of berths and channels, of wharves, sheds, buildings, roadways, water service, cleaning of wharves, general repairs. The operating of floating crane, electric hoists and the construction and maintenance of industrial connections with the harbor, were all carried on during the season with an even greater measure of success than usual.

The following important items of construction work and materials used will give an idea of the extent of the Commissioners' operations during the season:—cribwork built, 2,160 lin. ft.; cribwork sunk, 1,820 lin. ft.; quay walls completed, 2,518 lin. ft.; quay walls completed to half height, 1,159 lin. ft.; retaining and abutment walls completed, 1,228 lin, ft.; new track work, 4 miles; paving, 20,000 sq. yds.; dredging by Harbor Commissioners' dredges, 1,500,000 cu. yds.; dredging by Marine and Fisheries' dredges, 500,000 cu. yds.; refilling by derricks, 1,750,000 cu. yds.; filling obtained from city contractors, 200,000 cu. yds. The quantities of materials used were:—cement, 60,000 barrels; sand, 15,000 cu. yds.; crushed stone, 25,000 tons; rubble stone, 20,000 tons;

displacers, 500 tons; gravel, 8,000 tons; stone for macadamizing, 2,500 tons; timber used to amount of $215,000.

Preliminary studies have been made on a warehouse which is proposed to be erected on the high level at Beaudry Street, the construction of which is under consideration by the Commissioners. The building is designed to be about 400 feet long and 100 feet wide, to have six storage floors, of which five can be used the year round, and one, four feet above the Low Level wharf, will be available only the summer months, when the river level is normal. All floors will be designed to carry a live load of 300 lbs. per square foot of floor, and the six floors will be connected with four high-speed electric cargo elevators.

Owing to the greater demand for grain storage, the Commissioners have decided to make a second addition to No. 1 Elevator—on the west side—giving a further capacity of 1,500,000 bushels, making a total of 4,000,000 bushels. This will be ready early in 1916.

MAINLY CONSTRUCTIONAL

EAST and WEST — FROM COAST to COAST

The Pease Foundry Company, Limited, a Toronto concern, capitalized at $200,000, has been given a license to carry on business in the province of British Columbia.

A certificate of registration to carry on business in British Columbia has been granted to the Paraffine Paint Company—a San Francisco concern capitalized at $300,000.

A certificate of incorporation has been granted to the Fraser River Pile Driving Company, Limited, a new company capitalized at $10,000 and located at New Westminster, B.C.

The Canadian Bridge Company, Limited, of Walkerville, Ont., has been licensed as an extra-provincial company to carry on business in the province of British Columbia. The amount of the company's capital is $1,000,000.

A newly incorporated Montreal firm is the Montreal Architectural Iron Works, Limited, capitalized at $50,000. The incorporators include F. J. Coulter, W. S. Jones, C. A. Roberts, J. Gilmore and W. F. Lee, all of Montreal.

The Deakin Construction Company, Montreal, has been incorporated with a capital of $50,000 to carry on business as builders and contractors. The incorporators include E. E. Howard, J. DeWitt, H. C. McNeil and W. H. Howard, all of Montreal.

Early in the spring the Three Rivers Traction Company will commence the construction of the first section (six miles) of an electric street railway. The company is a subsidiary concern of the Shawinigan Water and Power Company, Montreal.

At Fort William, Ont., excavating has commenced for an addition to the Ogilvie Flour Mills elevator. The new building will provide an added capacity of 750,000 bushels. The architects and general contractors are Messrs. Barnett & McQueen, Fort William.

At Rock Island, Que., the buildings of the Rock Island Hotel Company and the Sherbrooke Railway and Power Company were destroyed by fire recently at a loss of $130,000. he Duval and Caldwell blocks were also destroyed. All the buildings are partly covered by insurance.

At Vancouver, last week, Mr. Justice Macdonald gave out a decision in favor of the Concrete Appliances Company, of Los Angeles, against a local firm for an injunction and damages for the contravention of the patent rights of a machine for mixing and distributing concrete.

La Compagnie Manufacturiere de Briques et de Construction de Saint Raymond has been incorporated with head office at St. Raymond, Que., and a capital of $20,000 to carry on business as contractors, brickmakers, etc. The incorporators include E. Page, A. Boisvert and D. Savard, all of Quebec.

At a meeting held in Toronto last week, it was agreed that the engineers representing the Harbor Board, Hydro-electric Commission and the City Council should prepare a general plan of improved transportation for the city and submit a plan to the Rapid Transit Committee not later than November 1st next.

The City of Ottawa will apply to the Legislature for permission to undertake the expenditure of $300,000 for extensions to the waterworks system. The projected work comprises the completion of the aqueduct and the intake pipe, and the construction of a sedimentation basin. The Waterworks Engineer is Mr. R. L. Haycock.

La Compagnie de Construction Generale du Lac Saint Jean, Limitee, with head office at Roberval, Que., has been incorporated with a capital of $10,000 to carry on business as general builders, contractors and manufacturers. The incorporators include A. Levesque, D. Neron and T. L. Bergeron, all of Roberval.

The Bricklayers' Union, Montreal, have come to an arrangement with the General Contractors' Association by which rates are reduced 10 cents an hour until October 1, the rate now being 45c. an hour. The Building Trades Council have protested against this action, and as the result of the friction the Bricklayers' Union have withdrawn from the Council.

In 1913 the sum of $6,667,000 was voted for a duplicate waterworks system at Toronto. Of this amount, $1,420,000 has been spent. The Civic Works Committee now recommends proceeding with the duplicate system. If the council aquiesces in the matter, the city will have to sell bonds to the amount of $5,247,000 for the installation of the Scarborough system.

We hear that St. John firms have been receiving a number of nice contracts lately. The Portland Rolling Mills, for instance, have been awarded a large contract for supplying steel to the Intercolonial Railway; the Phoenix Foundry have received a large order for shrapnel cases; while T. McAvity & Sons, Limited, have been given contracts for supplying brass plugs for the shells.

Work on the first Mormon Temple on British soil is now well under way at Cardston, Alta. The structure will be built of granite from the Rocky Mountains, and will cost at least $300,000. The new Canadian building will be the first to be erected outside the State of Utah. The Salt Lake Temple cost four million dollars, and was forty-five years in the building. The other Utah temples cost, all told, about three million dollars. There are some ten thousand Mormons in Canada to-day.

At a recent meeting of the Ontario Land Surveyors' Association, Mr. J. S. Dobie, Chairman of the Committee on Roads and Pavements, brought forward the suggestion of a highway running from Windsor to Montreal, as a war memorial. The idea which is under consideration, is that the expenditure, which is estimated at $8,000 a mile, shall be defrayed by municipal and private subscriptions,

So excessive are the prices asked by the owners of the property required for the right-of-way for approaches for the new high level bridge across the old Welland Canal that the city council of St. Catharines is considering changing the route. Work has been stopped on the construction of the substructure and will not be resumed until the owners decide to reduce their prices, or some other course is adopted.

Lectures delivered recently before the Graduate Students in Highway Engineering at Columbia University include the following: February 5th—"Methods of Cost Keeping for Highway Engineers and Contractors," by Mr. Arthur N. Johnson, Highway Engineer, Bureau of Municipal Research, New York City; February 12th—"Public Recognition of and Specifications for Patented Pavements," by Mr. George C. Warren, President, Warren Brothers Company.

Answering a question in the House of Commons last week, the Minister of Railways stated that the Hudson Bay Railway was completed up to mile 56 and partially ballasted to mile 175; that steel had been laid on 214 miles of main line. The railway would be finished in the autumn of 1917 and grain would be shipped that autumn from the terminals. The completion of the terminals, however, would require two years further, The total cost of the railway to the end of January last hand been nearly $9,800,000.

Somewhat of a sensation was caused in civic circles at Montreal last week when it was announced that fifteen indictments had been returned in the Court of King's Bench. in connection with the celebrated Notre Dame de Grace sewer. Etienne Pelland, formerly engineer in the city sewer department, was the only one who had been arrested in connection with the affair, so that the indictment of the others by the grand jury was a surprise. It is alleged that the city was defrauded out of $75,000 in connection with the construction of the sewer in question.

At the thirty-third Annual Convention of the Mutual Fire Underwriters' Association held recently in the Carls-Rite Hotel, Toronto, the President, Mr. Thomas Hoskin, stated that Canada's fire record was the worst in the world, and that her fire losses would pay off the national debt in less than twenty years. Wooden buildings, badly constructed chimneys, and sparks from engines were given as reasons for the fact that fire losses in Canadian cities were seven times greater than in Great Britain. Brick veneered and cement block veneered dwellings were placed in the second class risks.

Despite the pessimistic reports of the building situation at Montreal, it is gratifying to find that comparative statistics for 1914 and 1915 are not so widely apart after all. Last month 107 permits were issued for buildings estimated to cost $441,980, while in February, 1914, the number of permits issued was 156, and the value was $496,055. During the first two months of the present year 180 permits were issued, representing an estimated expenditure of $645,241, as against 257 permits and $905,700 for the corresponding period of 1914. The returns are compiled by Mr. Alcide Chausse, the City Building Inspector.

The city of London, Ont., plans to expend $200,000 on street paving this season. The figure sets a new local record, and will provide for about five miles of permanent surfacing, which will bring the total mileage of paved streets up to at least eighteen miles. The expenditure last year in this department was $126,168. The work this season will be in charge of Acting City Engineer, Mr. H. A. Brazier, who, it will be remembered, is acting in the senior capacity in the absence of City Engineer Ashplant on active service. Most of the new paving work is for asphaltic concrete, with a few short sections of vitrified brick and concrete.

Apropos of the statement in these columns last week of the Calgary Bricklayers' Union bidding for the new relief sewer, Chief Engineer Craig presented some interesting figures at a recent meeting of the city council. The Bricklayers' Union offered to build 5,000 ft. of sewer at a cost of $1 per foot, including all labor costs. This does not include the cost of material, tools or machinery. Three separate individuals belonging to the Union offered to do the work at 90 cents a foot. Including the price of the brick, the cost of the work on the basis of the Bricklayers' Union figure would be $3.45 a lineal foot. The City Engineer's estimate, figuring on labor at 70 cents an hour, was $3.22½ a lineal foot. The same work done in concrete is estimated to cost $2.84 a lineal foot.

The Montreal Board of Control have voted an appropriation of $550,000 for the laying of additional conduits, much of the work being in the nature of linking up the sections already completed. The work will be on a portion of St. Lawrence Boulevard from Craig Street to Sherbrooke Street, also the section of the city between Notre Dame Street and Commissioners Street, and a further section on McGill Street to St. Lawrence Boulevard; from Craig and St. Antoine Streets from Victoria Square to Windsor Street; on St. James Street from McGill Street to Windsor Street; on Notre Dame Street from McGill Street to Bonaventure Station; and on Windsor Street from Bonaventure Station to St. Catherine Street. The electrical Commission are preparing plans and specifications for this work.

The Provincial Builders' Association, at its annual convention held last week in Ottawa, elected the following officers: President, Mr. George Gander, Toronto; First Vice-President, Mr. T. R. Wright, London; Second Vice-President, Mr. Charles Chapman, St. Catharines; Secretary, Mr. A. E. Flower, Toronto; Treasurer, Mr. George Oakley, Jr., Toronto. Executive Committee, Messrs. J. S. Webster, Galt; G. A. Crain, Ottawa; George Metcalfe, Hamilton; J. Norton, Sarnia; C. Bulley, Toronto; M. R. Bogart, Chatham; J. Shultz, Brantford; J. L. Youngs, Stratford; J. Green, St. Thomas; Casper Braun, Berlin; H. P. Nicholson, St. Catharines; L. H. Martyn, London, and O. Bogue, Peterborough. The association will ask the Government to do all in its power to carry on as much building as possible during the hard times, to encourage the use of Canadian materials and labor, and to discourage foreign labor and material.

A special engineering corps of five hundred Canadian engineers is to be organized by the Canadian Pacific Railway for service at the front. A request was received some days ago from the War Office for the formation of such a corps, whose duties it will be to rebuild bridges, replace right-of-way, and perform other work of this kind. Vice-President George Bury, of the Canadian Pacific Railway, has, it is learned, agreed to undertake this work, as the railway is naturally in a better position to secure the right kind of men than the Government would be. The heavier equipment for this corps will be supplied by the British War Office, but the smaller and lighter equipment will be supplied in Canada and transported with the corps. The great importance of communication lines, particularly lines of railway ,for the rapid movement of troops has been emphasized in the developments on both the main battle fronts, and it is believed that Canada is in a position to supply a corps of men highly trained in the work of constructing and repairing lines of railway, bridges, and works of that character. The corps which Vice-President Bury has undertaken to organize will be commanded by a man high in the engineering work of the Dominion.

From Fort William, Ont., comes the report that a contracting firm of that city, Messrs. Beaton & McLeod, moved a 140-ft. steel water tower to a location 200 ft. west of the old site in five days. The tower supported a tank with a capacity of 50,000 gallons. The four posts of the tower rested upon square steel plates, which were bolted to the concrete foundation. A track was built on which to run the tower, and then the tower was slowly jacked up until it was possible to slide in timbers and hardwood shoes, below which were inserted the 7-in. rollers. The operations were conducted as in the case of other heavy structures, by means of block and tackle operated by teams. Owing to the top-heavy nature of the framework, the utmost care had to be taken to keep all the rollers in proper alignment. The task was carried through without a hitch. The average number of men employed was seven. The work was contracted for under guarantee.

Personal Mention

Mr. H. M. Burwell, of Vancouver, is retiring from the civil engineering partnership of Hermon & Burwell and is entering upon an individual practice.

Mr. H. C. Blackwell has been appointed Engineer to G. M. Gest, Limited, conduit engineers and contractors, Montreal, Winnipeg, and Vancouver, in succession to the late Mr. Stannard.

Mr. Percy E. Nobbs, Professor of Architecture at McGill University, and a partner in the firm of Nobbs and Hyde, Montreal, is going to the front with the Northumberland Fusiliers.

Mr. W. H. Hazlett, of Vancouver, for twelve years Purchasing Agent with the British Columbia Electric Railway Company, has joined the consulting engineering firm of Messrs. A. G. Langley & Company, Limited.

Mr. W. Erye Colwill, architect, Guelph, Ont., has taken into partnership Mr. Boothe, of Toronto. The firm in future will be known as Colwill, Boothe & Company. They have already a considerable amount of work in hand.

Mr. A. K. Grimmer, the retiring City Engineer of Medicine Hat, leaves the West for his old home at Saint Andrews, N.B., about March 10. Correspondence should be addressed to him at Saint Andrews until further notice.

Mr. P. Mercier, the assistant engineer of the Montreal Council, is ill with a slight attack of paralysis, and Mr. G. Janin, the chief engineer, who is on military duties, has returned to Montreal for a short time in order to give assistance to the Council.

Mr. E. T. Nesbitt, the Quebec contractor, is spending a holiday in Bermuda. For some time he has been in anything but the best of health, and it is hoped that the change will be of much benefit to him. Mr. Nesbitt is an Honorary Life President of the Canadian National Association of Builders' Exchanges.

Captain D. L. Hough, M. Am. Soc. C. E., President, Cuban Engineering and Contracting Company, New York City, on February 23rd delivered lectures on "The Relation of the Contractor to the Engineer," and "The Highways of Russia," before the graduate students in Highway Engineering at Columbia University.

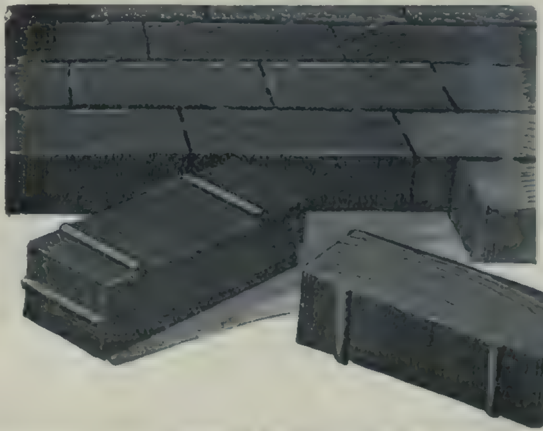
Mr. T. Linsey Crossley, of the Donald Laboratories, delivered an interesting address on the subject of Asphalt Pavements before a recent meeting of the Society of Chemical Industry at Montreal. One of the suggestions made by Mr. Crossley was that asphalt, although not found in Canada, might well be refined here, as its increasing use in Canadian cities should make it possible to refine it profitably in this country.

Mr. Henry W. Durham, M. Am. Soc. C. E., former Chief Engineer of Highways, Borough of Manhattan, New York City, on February 26th delivered an illustrated lecture on "The Relation of Tests of Physical Properties and the Wearing Qualities of Paving Materials," before the graduate students in Highway Engineering at Columbia University.

Mr. Arthur H. Blanchard, M. Am. Soc. C.E., Consulting Highway Engineer and Professor in charge of the Graduate Course in Highway Engineering at Columbia University, delivered an illustrated address on the subject "Economic Phases of Highway Engineering" before the Middletown Scientific Association at its recent meeting at Wesleyan University.

Permanent Paving

Street specifications are vigorously attacking the few remaining problems involving the permanence of modern creosoted wood block pavements. It is claimed for this type of pavement that it more nearly approaches the requisites of the ideal pavement than any other known paving material. In order to obtain a smooth pavement engineers have always recognized the fact that the resultant surface would necessarily be more or less slippery in certain seasons of the year. The only exception to this rule is a lug block pavement.


Details of Kreolite Lug Block.

Kreolite Lug Wood Block make a better pavement than the old type of ordinary rectangular creosoted wood block because they retain all of their advantages and none of their faults. For this reason municipal engineers and other city officials interested in pavement permanence are specifying them on a large scale in all parts of North America. Experience has shown that they are equally as good on level, and grades as high as 7 per cent., in preventing slipperiness.

Kreolite Lug Block not only prevent slipperiness but multiply the factor of safety against the possibility of bulging and bleeding.

The details of an individual Kreolite Lug Block are shown in the illustration. It will be noted that the lugs are an integral part of the block, extending its full depth in the direction of the grain. The lugs on the side of each block separate the courses, making a good strong grip for the hoofs of horses and the chains of automobile wheels. At the same time the two side lugs are compressible, absorbing any possible transverse expansion or swelling and preventing the pavement from otherwise following the line of least resistance and buckling.

The lug in the centre of one end of each block is pointed, or wedge-shaped, so that it acts as a uniform, collapsible spacer. This lug generally protrudes ¼-inch from the surface of the block. The least pressure exerted by the swelling of the wood is concentrated on the points of the lugs, gradually crushing them as the force increases, allowing the pavement to expand as a whole, at will, within itself, without buckling. The end lug also tends to prevent transverse skidding and slipping.

Large quantities of creosote oil have been forced into creosoted wood block pavements in the effort to prevent the absorption of water and consequent expansion or buckling of the pavement. Since the lugs automatically take care of any possible expansion, it is only necessary to treat the blocks with sufficient creosote oil to prevent decay, and an injection of 12 pounds of creosote per cubic foot is ample to postpone the decay of the blocks indefinitely. Practical tests have proven that this quantity of injected creosote precludes the possibility of the oil exuding or bleeding to the surface of the pavement.

The value of the lug as a factor of safety against expansion has been repeatedly demonstrated in such cities as Toronto, Detroit, Toledo, Cleveland, New York City, Baltimore, Harrisburg, Columbus, Nashville, New Orleans, etc., etc., throughout sufficiently variable climates to denote proof of greater efficiency.

This type of block is not only superior to the ordinary rectangular block for paving streets, but is unsurpassed for paving between car tracks. In many instances engineers have hesitated to use wood block construction between their car tracks for the reason that such material has been known to expand and push the rails out of alignment, at the same time to prove slippery and cause embarrassment of service owing to blockades due to fallen horses.

A Kreolite Lug Block overcomes all of these difficulties and is the most modern and inexpensive improvement over the ordinary rectangular creosoted wood paving block.

Mr. Frank B. Goodman, Toronto, is the Canadian sales representative of the Jennison Wright Company, Toledo, Ohio, the manufacturers of this block.

"Business as Usual" in New Brunswick

NEW Brunswick is reported to be living up fairly well well to the business slogan. Almost all the provincial communities are showing progress. St. John is going on with its harbor development work, with the construction of the bridge across the Falls, with the new post office and other enterprises. The new sugar refinery has begun work. A bond issue has been made for water extension to the amount of $24,000. The winter export business has been well sustained. Sackville has decided to issue $40,000 in bonds for water and sewerage extension. Moncton is replacing the churches and schools recently burned with fine new structures. Sussex has been doing a lot of construction work; it is estimated that in the last two years about $500,000 have been expended in the erection of public and private buildings at Sussex. St. Andrews has almost completed its $300,000 summer hotel. The re-opening of the million-dollar sardine factory will also tend to boom that locality. St. Stephen industries are booming. The new shoe factory has been opened and orders are pouring in fast. The soap factory and the other industrial establishments in that thriving border town are doing a satisfactory business. Woodstock, Fredericton, Edmundston and the North Shore towns are all doing their share in maintaining the slogan of "Business as Usual." On the whole a sane and satisfactory business campaign is in progress in New Brunswick.

Market Conditions at Toronto

IN the brick field there is displayed little sign of life. Prices have decreased materially, but were trade to revive they would probably regain their previous level. The situation in the cement business is fair, and manufacturers hope that the returning spring will improve their trade. The prices for lime, plaster of paris, etc., have not been definitely arranged and will continue as listed for another month or so. Regarding the steel industry, the recent change in tariff will undeniably alter the prices, but nothing definite has been fixed regarding these yet. The mills will probably issue the new rates in a few days. Some orders have been given for paint, but shipments are being withheld for some weeks for better weather conditions. Perhaps the signs of a slightly growing activity are being felt in the lumber market more than in any other. The price of lumber has come down, and a number of enquiries for prices, more especially from the country, are coming in, although the immediate sale is small indeed.

Publications Received

"Concrete Stone Manufacture," by Harvey Whipple. Published by the Concrete-Cement Age Publishing Company, Detroit. Price $1. This book is the first comprehensive work on its subject written in eight years, during which period the industry has shown remarkable progress in many ways. It is pointed out that the development of factory-made concrete units has not kept pace with the development of field-made concrete in mass. Failures in the field of manufacture have shown that in the making of concrete products skill, judgment and workmanship must be brought to bear. The book is well illustrated, and some idea of its comprehensive scope may be obtained from the subject-matter of the various chapters, which is as follows:—Chap. 1.—The Development of Concrete Building Units; 2.—Location, Equipment, Layout; 3.—Materials, Mixtures, Manipulation; 4.—Curing; 5.—Special Molds and Patterns; 6.—Surfaces; 7.—Shop Records and Cost Keeping; 8.—Building Regulations—Tests—Specifications; 9.—Selling the Products; 10.—Examples of Layout and Operation. The author of this book is well known as the Managing Editor of the Concrete-Cement Age, Detroit, Mich.

* * *

From the United States Cast Iron Pipe and Foundry Company we have received a copy of their latest general catalogue relating to cast iron pipe. This catalogue, which is bound in stiff covers, is excellently arranged, and is well illustrated by tabular matter, line cuts and half-tone illustrations. The material which it contains cannot fail to have a high educational value either to the student or to the consumer. The history and development of cast iron pipe is outlined in the prefatory pages in a manner which could not be excelled in the most up-to-date encyclopaedia, while the general notes illustrating the range and application of cast iron pipe are particularly well written and comprehensive. The tables given cover a full line of pipes and fittings with accompanying specifications, which have been adopted in the United States as the manufacturers' standards, and represent those most commonly used. In the preparation of plans for new works or extensions to existing installations the adoption of these standards will facilitate the making of inquiries and estimates and the filling of orders. Notes are included regarding the forms of joints, recent developments in high pressure piping, and other data of possible interest to those considering the use of pipe; and some tables have been added which will be helpful in determining pipe sizes and capacities. Attention is directed to an additional section in this catalogue illustrating miscellaneous foundry products. The United States Cast Iron Pipe and Foundry Company operate works at Addyston, Ohio, Anniston, Ala., Bessemer, Ala., Birmingham, Ala., Buffalo, N.Y., Burlington, N.J., Chattanooga, Tenn., Cleveland, Ohio, Columbus, Ohio, Louisville, Ky., Scottdale, Pa., and Superior, Wis., illustrated descriptions of which are given in the catalogue. The general offices of the company are at Burlington, N.J. Canadian inquiries should be addressed to the General Sales Office, Philadelphia.

* * *

From the Buffalo Forge Company, Buffalo, N.Y., we have received three new catalogues—Nos. 200, 201 and 182-E—which are of special interest.

Catalogue No. 200 is on Buffalo Planoidal fans, a modification and improvement on the older type of steel plate heating and ventilating fans, with a comparatively small number of radial blades. With the improvements in design which have been made, this type of fan will, for most conditions, compete on an equal basis with the multiblade fans.

Catalogue No. 201 relates to Niagara Conoidal fans. Besides having all the advantages of the multiblade type in respect to higher operating speeds, more compact arrangement, and greater rigidity, the shape of blades and proportion to the housing used in the Niagara Conoidal make it possible to convert into static pressure the velocity head, which is much higher proportionately to the total pressure with multiblade fans than with older types having few blades.

Catalogue No. 182-E is a collection of the various types of blowers and exhaust fans, which are regularly built for direct connection to motors. This includes everything from large ventilating and drying fans down to the little Baby Conoidals for the ventilation of moving picture booths, drying cabinets, etc., and electric blowers for single forge fires, which take less than half the horsepower of an ordinary electric lamp.

New Rolling Mill in Operation at St. Paul, Que.

A noteworthy industrial development in the province of Quebec is the opening of a new rolling mill at St. Paul by the Canadian Rolling Mills Company. The construction of the new plant was started a year ago, and the work has gone steadily ahead to completion. The operations of the mill will be confined, for a time at least, to the manufacture of merchant bar-iron and steel, the greater part of which will be used by The Canadian Tube and Iron Company and The Colonial Wire Company, which are controlled by the same management. The plants of all three companies are situated in St. Paul, bordering on the Lachine Canal, and employ some eight hundred persons.

One of the features of the up-to-date equipment of the new plant is a huge electric crane which will unload a coal boat carrying 2,300 tons within twenty-four hours. When working at capacity the company expect to manufacture to the extent of 45,000 tons a year. Mr. J. L. Waldie, the General Manager, states that orders have been received in satisfactory volume, and that the outlook for spring business is good. The orders have come principally from Ontario, Quebec, and the Maritime Provinces.

The Colonial Wire Company has been running to capacity for export delivery on fine wires, wood screws, and other products. Before the war a large portion of British trade in these products was handled by German companies. The readjustment of the business has enabled the Canadian concerns to secure large orders from Great Britain, Australasia, India, China and Japan. At present they have orders which will keep them busy for the next six months. Mr. Waldie is of opinion that much of this new trade will be retained after the war, and he is optimistic concerning the prospects for 1915.

Concrete Mixer for the Small Contractor

To supply the needs of the smaller contractors who do not require a machine as expensive as the larger ones that have been manufactured by this company for many years the Chain Belt Company, of Milwaukee, Wis., has put on the market a concrete mixer that it styles the "REX." The machine offers the contractor an opportunity to obtain at a reasonable price a high quality, low charging machine. This machine is especially designed for the contractor who builds concrete silos, culverts, basements, floors and other work where a higher-priced machine would not be justified. The Rex mixer has a capacity of 6 cubic feet of loose materials or 5 cubic feet of mixed concrete per concrete in about 45 seconds. The machine is driven by a Novo 3 horse-power gasoline engine, a reliable outdoor engine simple in construction. This engine is a vertical hopper type, water-cooled, 4-cycle, and being entirely enclosed by a steel housing is frostproof and can not be damaged by water freezing, thus being particularly adapted for outdoor work in the most severe climates. The fuel supply is carried in the base of the engine and is sufficient for a day's run. A feature of the Rex mixer is its low construction, the charging platform being about 18 inches above the ground, making it necessary only to run the wheelbarrow up a very easy incline in order to charge the mixer. The machine is driven by a rivetted Chain Belt which is declared to be the most durable and efficient drive ever placed on a concrete mixer. Having in view the fact that a machine of this type will be hauled over all kinds of roads, the Rex is equipped with large diameter road wheels with 4-inch face and with the same gauge as the standard wagon gauge.

The Rex concrete mixer.

While the machines are sold at a low price they are in no sense cheap machines, the low price being due to the fact that they are made in large quantities and that all parts are made in the company's factory at Milwaukee.

Messrs. Mills Bros., Ryrie Building, Toronto, are the Ontario Sales Agents for the Chain Belt Company.

The Turbine Equipment Company, Limited, Toronto, have received several orders during the last few weeks. One is from the John verMehr Engineering Company, Toronto, for one 2-million gallon electrically-driven De Laval centrifugal pump, and two 1-million gallon, and two ½-million gallon pumps of the same type. Another order is from the Swedish General Electric Company for the Standard Chemical Company, Longford, Ont., for one 3½-million gallon De Laval, single stage, double-suction, centrifugal pump, to operate against 125 ft. total head. This pump will be direct connected to a Swedish General Electric Company's motor. The Cobalt Reduction Company, Cobalt, Ont., has also placed an order for two 1-million gallon De Laval electrically-driven centrifugal pumps, each to operate against 75 lbs. pressure. From J. R. Booth, Ottawa, Ont., has been received an order for one special De Laval 6-in. stock pump, which will be motor-driven.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Aylmer, Que.
The Quebec Legislature have approved plans for intake pipe. Estimated cost $12,000. Tenders will be called shortly. Engineer to Town Council, H. Leblanc.

Brant Township, Ont.
The Township contemplate laying a cement sidewalk on Wilkes Avenue. Clerk, J. A. Smith, Court House, Brantford.

Crompton, Ont.
The Village Council propose to lay a number of cement sidewalks in the spring. Trustee, F. E. Kestle.

Duncan, B.C.
The City Council are contemplating the construction of 61 miles of pipe line from Holt Creek. Clerk, J. Greig.

Dundas, Ont.
The Grand Trunk Railway Company are considering the construction of concrete abutments and retaining walls on Sydenham Road.

Eastview, Ont.
The Town Council are considering the construction of a sewer on Montreal Road, between the Rideau River and Mona Street. Clerk, H. Washington. Estimated cost, $3,000.

Ekfrid Township, Ont.
The Township Council propose to make extensive repairs to drains in the spring. Clerk, A. P. McDougall, Melbourne, Ont.

Hamilton, Ont.
Tenders will be received by the Mayor until 5 p.m., March 18th, for the following:—880 ft. of 36-in. cast iron pipe and specials; 2,280 ft. of 36-in. cast iron pipe and specials; and making and laying 1,400 ft. of 36-in. reinforced concrete pipe. Specifications from City Engineer, A. F. Macallum.

Howard Township, Ont.
The Township Council contemplate the construction of steel and concrete culverts over a number of drains. Commissioner, P. Shewburg, Ridgetown, Ont.

Mount Forest, Ont.
The Town Council are in the market for road grader and other road machinery. Clerk, W. C. Perry.

Niagara Falls, Ont.
The City Council will probably call for tenders shortly for one oil sprinkler. Clerk, W. J. Seymour.

Stratford, Ont.
The ratepayers have passed a by-law involving $72,000, for laying a large amount of concrete sewer pipe. Tenders will probably be called for later. Clerk to City Council, R. R. Lang.

Toronto, Ont.
R. C. Harris, Commissioner of Works, has recommended laying concrete sidewalks on St. Clair, Willard and Welland Avenues. Estimated cost, $4,500.

Tenders close March 16th for construction of sewers on Laughton Avenue and West Toronto Sewer System No. 2 Outlet. Plans from the Commissioner of Works, R. C. Harris, City Hall.

Warwick Township, Ont.
The Township Council are about to make extensions to the drainage system. Clerk, N. Herbert, Watford, Ont.

Waterloo, Ont.
The City Council are contemplating paving, estimated to cost $11,600, on Allen and Duke Streets, and the construction of sewers on Allen Street at a cost of $1,400. Clerk, J. C. Haight.

CONTRACTS AWARDED

Nanaimo, B.C.
The City Council have awarded contract for paving on Haliburton, Skinner and Front Streets to H. S. Kaiser, 718 Granville Street, Vancouver. Estimated cost, $50,000.

Ottawa, Ont.
Contracts for supply of sewer pipe have been awarded to local firms by the Board of Control as follows:—Gartcraig Scotch pipe, T. Sidney Kirby Company, 213 Sussex Street; Canadian pipe, Barrett Bros., Catherine Street, and Ottawa Fireproof Supply Company, 539 Sussex Street.

Toronto, Ont.
The following contracts for the construction of sewers have been let by the Board of Control: Dundas Street, $2,778, to Moyes Construction Company, 592 Gerrard Street E.; Carlton Street, $2,187, to Routly & Summers, 47 Sparkhill Street.

Winnipeg, Man.
The general contract for erection of frame camp buildings for the Greater Winnipeg Water District, 901 Boyd Building, has been awarded to F. Windels, St. Boniface, at $7,031.

Railroads, Bridges and Wharves

Armstrong's Corner, N.B.
Hon. J. Morrisey, Minister of Public Works, Fredericton, N.B., will receive tenders until March 31st for construction of Merritt Bridge, consisting of one fixed steel span, 94 ft. long, with reinforced concrete base, etc. Plans and specifications from Provincial Engineer, A. R. Wetmore, Fredericton. Specifications at office of MacLean Daily Reports, 25 Charlotte Street, Toronto.

Brantford, Ont.
The Street Railway Commissioners will hold a meeting to decide whether work on the proposed extensions to street railway shall be done by contract or day labor. Chairman, C. H. Hartman, 230 Colborne Street.

Burford Township, Ont.
Tenders will be received until April 3rd by T. W. Taylor, Cathcart, Ont., Clerk to Township Council, for construction of steel highway bridge, 60 ft. long. Gravel and cement will be supplied by Council.

Cookstown, Ont.
Tenders for construction of two bridges on side road, will be received until March 10th by W. Dinwoody, Cookstown, Clerk to Township Council.

Halifax, N.S.
The Furness Withy Company are about to rebuild a large portion of their wharf which collapsed recently. Estimated cost, $75,000.

Hamilton, Ont.
The Board of Control have decided to ask the Provincial Hydro-electric Railway to survey route for radial line from Hamilton to Fort Erie.

Three Rivers, Que.
Extensive repairs to wharf here have been started by the Dominion Government Department of Public Works. Secretary, R. C. Desrochers, Ottawa. Estimated cost, $75,000.

Toronto, Ont.
Tenders will be received until March 16th by the Board of Control for the following materials for construction of street railway on Lansdowne Avenue:—(a) track materials, rails, plates, bolts, spikes; (b) overhead line materials, wire fittings, etc.; (c) oak ties. Specifications at office of Purchasing Department, Room 12, City Hall. Commissioner of Works, R. C. Harris.

The engineering staff of the Provincial Hydro-electric Commission, Toronto Harbor Commission and City Works Department, are about to prepare plans for general scheme of radial railways. Report to be submitted to Board of Control by November 1st. E. L. Cousins, Chief Engineer of the Harbor Commission, has the work in hand.

CONTRACTS AWARDED

Brantford, Ont.
The contract for three cars to cost $12,000 has been let by the Street Railway Commission to Preston Car & Coach Company, Alfred Street, Preston, Ont.

Public Buildings, Churches and Schools

Berlin, Ont.
Tenders will be received until March 15th by P. Ringle, 115 Water Street, Secretary to Separate School Board, for erection of school on Strange Street. Plans and specifications at office of J. Mickler, Duke Street, Preston, and from Secretary. Brick construction. Estimated cost, $15,000.

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"Unfortunate Experiences" With Architects

OVER leaf we publish an article by Mr. R. M. Fripp, F.S.A., President of the Architectural Institute of British Columbia, which constitutes an able presentment of the case for the architectural profession, but—one does not have to look very far for the flaws.

It is not sufficient to infer that the editorial article, "Inefficiency in Architectural Practice," published in our issue of January 20, was based on false premises, or to say that its deductions were unsound. It is partaking too much of the generalities of which the writer of the letter accuses us. As a matter of fact, there could have been little wrong with either our premises or our deductions, seeing that our whole argument was based upon decisions handed down in the courts.

We wonder how many owners have "suffered from an unfortunate experience" the possibility of which Mr. Fripp suggests. Nay, rather, we wonder how many have not. You can go to Toronto and point to the General Hospital, the C. P. R. Building, the Dominion Bank, and other buildings which stand as a permanent memorial to the ability of men like Frank Darling; but, on the other hand, you can go to Toronto and point to ten thousand odds and ends of constructional misfits for which the responsibility attaches to the rank and file of the profession. Select ten building owners in Toronto, and you will find that nine of them have had "unfortunate experiences" with architects. One will tell you of inefficiency in design, and another of a bad bungle in the interior planning; Brown will tell you of changes and alterations which ran him into untold extras; Smith will swear that there was an understanding between his architect and the contractor; Jones will string off so many charges of negligence in the supervision of his factory or office building that you will be prepared to give up the ghost. There seem to be more "unfortunate experiences" with architects than with any other type of business or professional men.

Mr. Fripp belittles the evil by urging that the same shortcomings are to be found in every profession, and expresses gratification at the admission that 17 per cent. of the profession is efficient. With this, however, we are not in accord. The professional man we like least after the architect is the lawyer. In the legal profession we find more sharp practice, perhaps, but less inefficiency. It would be hard indeed on the public if only 17 per cent. of the medical profession were qualified men. And certain it is that if only 17 per cent. of the journalistic community understood their business properly they would have to have recourse to some other means of obtaining a livelihood. We make these observations not unkindly, but because we are satisfied that the standard of attainment in architecture wants raising, if only in the interests of a number of excellent men who adorn the profession.

Mr. Fripp tells us that the reason the efficient members of the profession do not do something to raise the standard is because the Provincial and Federal Governments have discouraged their efforts and turned down their proposals. Does not this in itself point to lack of organization and executive ability? The architects have a governing body called The Royal Architectural Institute of Canada, but few know anything of its work but the architects themselves, despite the highly ornate and dignified adjectival prefix. It has been urged that the Canadian Society of Civil Engineers has not done enough for the engineering profession in the way of securing public recognition, but it could not be urged that the C. S. C. E. is not one of the best-known bodies of its kind in America, or that it has not played a really creditable part in upholding the standard of professional attainment in its special sphere.

Finally, as a cloak for all kinds of constructional shortcomings, we are told that between supervision and superintendence there is a great gulf fixed. In the manner in which construction is organized in this country, and where a Clerk of Works is not employed, architectural supervision must include a considerable measure of architectural superintendence,if the work is to be carried out creditably and reliably. It would never occur to an efficient architect to watch the operation of a concrete mixer. It would occur to him to turn up on the job at such unstated and irregular times during the performance of the work as his knowledge of its progress and his experience of sharp practice might dictate.

Mr. Fripp has undertaken to reply to the charges made against the profession, and he has made the best out of a bad case. There remains little to add except that it is a matter of gratification to us to have the discussion taken up by such an able and well-informed correspondent as the President of the Architectural Institute of British Columbia.

Inefficiency in Architectural Practice

By R. M. Fripp, F. S. A., Vancouver B. C.*

As one of those who have followed the practice of architecture during many years in the West, perhaps I may be permitted to reply to an article, entitled, "Inefficiency in Architectural Practice," published in The Contract Record of January 20th.

Doubtless this article contains a good deal of truth, but it appears to be too general in its condemnation and not by any means sound in all of its deductions; moreover, it offers no solution of the problem. The classification of types of practising architects is sufficiently correct, but the conclusions respecting their relative values are anything but accurate. Further, there is no explanation of the means or process of reasoning by which the proportions of these several types is arrived at. The pessimistic views expressed by the writer, who possibly may have suffered from an unfortunate experience, are supported and illustrated by cases which have apeared in the courts. But surely it is not denied that architects have responsibilities and that some of them are negligent, or incapable, or both, and that in such instances they have to suffer the usual penalty. Cannot precisely the same be urged against every profession, be it Medicine, Law or Journalism? The inefficiency of the architect is so easy to demonstrate from the very nature of his work, which remains to give evidence against him, whereas the medical profession buries its worst mistakes, and the legal fraternity is well paid for its blunders. Upon the whole it is satisfactory to learn that 17 per cent. of practising architects may be classed as "all-round efficients." Can it be suggested seriously that as large a proportion of the writers and editors of Canadian journalism are wholly capable, well-trained and clever writers, critics and men of business? It would take an amazing degree of credulity to assess 17 per cent. of the legal profession as "all-round efficients," even including all the politically-created judges and K.C.'s. Were the average set of contract drawings no worse prepared than is the average case presented to the courts, the probability of structural failure would be 50 per cent. and the premium upon accident policies would climb skyward like an aeroplane under fire.

The dictionary definition of an architect scarcely suffices. One skilled in the art of building may be an engineer, a contractor or a carpenter, and not necessarily an architect. What is the "art" of building? There is art, high art, industrial art, and so forth. Building per se is not an art except in the industrial sense, and is therefore not an art as implied in "architecture," to which level it rises only when it posseses a certain subtle quality which cannot be conferred upon it by mere constructive skill and excellence of workmanship. Hence it follows that the practical man, even though he be an engineer and a really skilled constructor (which the so-called practical man as a class or a type emphatically is not), cannot and does not give us Architecture. The very best he can produce is sound building. On the other hand, the despised artist type (despised by the writer of the article) certainly, if a graduate of a good European or American school of architecture, can and usually does give his clients sound and even clever planning and an agreeable grouping and detailing of parts, and he rarely fails to produce infinitely better results than the self-made man who knows little if anything beyond the merest rule-of-thumb methods and is necessarily utterly ignorant of planning. On the other hand, though the school man may not be able to push a wheelbarrow, he is quite able to judge when such important things are well done. As a matter of fact, it is quite well known that the self-made practical man type does very rarely evolve a respectable architect, whereas the notable successes, as well as the bulk of architects of a fair average capacity, must come from the schools which alone can give the higher education. The author of the article gives a type No. 3, the member of which in plain English is a rascal. Type No. 3, be it remembered, is strongly reinforced by recruits from the self-made. That section of the public which employs type No. 3 does so because he is cheap, and that is all there is to it. We have the shyster lawyer, the ward politician, the quack doctor—why should it cause surprise that we have the bum architect? They all appeal to the same public taste—to the same predatory instinct.

Why do not the efficient architects do something to raise the standard of professional competence? Simply because provincial and federal legislatures refuse the enabling legislation. A registrataion bll which proposed to render examination compulsory has been turned down three times by this provincial legislature. Even in those provinces where such a bill has been enacted the educational facilities are either non-existent or wholly inadequate. The young Canadian who wishes to become an all-round efficient architect must seek in Europe or the United States the higher training denied him by his own country. Having spent his years and his money, he returns to find himself in competition with the practical man, the self-made man, the shyster, and all the tribe of incompetents that are encouraged by the action of the legislatures and the preference of the public to style themselves "architects." For several years the Pylon Club, Vancouver, has declared in favor of education before registration, and this policy is certainly favored by the Architectural Institute of B. C. It is considered most desirable that a school of architecture should be established in our new university, but apparently it is too early to do more than agitate gently. In brief, it may be stated that such inefficiency as exists is due to the absence of educational facilities on the one hand, and the blank refusal of legislative bodies to pass sufficiently restructive legislation on the other. There being no compulsory test of qualification, the undesirables and the inefficients pour in at the open door.

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*President, Architectural Institute of B.C.; Past President, Pylon Club of Vancouver, B.C.

There is one other point which demands reference: the writer of the article confuses Supervision and Superintendence. Occasional inspection of the work constitutes the former; daily and close attention to the work, such as that given by a Clerk of Works, constitutes the latter—which is a matter for special arrangement between the owner and the architect. Both in Great Britain and France it is an invariable custom for architects to appoint and the owner to pay a Clerk of Works, and it is the only custom which brings best results. It is absurd to expect an architect whose business it is to plan, arrange, direct and create, to waste his time watching the operation of a concrete mixer, the wiping of plumbers' joints and the driving of nails. As well set a race horse to pull a manure cart. Such things may well be left to the talents of the "practical man."

"Going Broke" in Road Contracting

Mr. William R. Ray, State Highway Commissioner of Washington, states in his last annual report that many contractors recently have "gone broke" in road work in that state. Unfortunately the state of Washington is not an exception in that respect.

The primary reason for such financial failures of contractors is ignorance of road building costs. The item of grading is almost invariably underestimated by those who have previously done little or no roadwork. Yet, if contractors were more given to reading there would be fewer mistakes on this score. Fourteen years ago the publication of Gillette's "Economics of Road Construction" made clear the fact that road grading normally costs much more per cubic yard than railway grading. Not only the smaller yardage per mile, but the large amount of trimming subgrades, ditches and slopes result in higher unit costs for roads than for railroads. Hence the railroad contractor is in grave danger of underestimating road grading unless he reads and studies the literature of the subject.

The first cost of a modern road making plant and outfit is high in relation to the total amount of work done with it each season. A $50,000 contract that must be completed in one road-building season will normally require an investment of fully $15,000 in plant and equipment. If motor trucks or traction engines and trailers are used, the plant investment will exceed this amount. A very expensive quarrying and crushing plant adds still more to the investment. The relatively short road-building season in many states, coupled with the large investment in plant, should serve to make a contractor "count the cost" with great care. Yet it often seems to the experienced road contractor that each year breeds a new crop of fools who count the cost not at all.

Publicity as to costs and as to the failure of extremely low bidders may ultimately eliminate most of the "fool bids," but the process is slow at best.

We note that Mr. Ray favors letting road contracts for a lump sum rather than by unit prices. This, he reasons, has the effect of eliminating unbalanced bids and of making bidders more careful. Of 51 lump sum contracts 90 per cent. were completed at a cost to Washington state that was less than the engineer's original estimate. But of 52 unit price contracts only half were completed below the engineer's estimate.

We think that too much significance should not be attached to these results. They may simply mean that twice as many contractors "went broke" under unit price contracts. That is usually the case. Lump sum bidding is the most risky sort of contracting. The risks are enough at best. We do not favor making them worse by asking contractors to do all the guessing as to the percentages of rock, hardpan, and the like. Except under unusual or obviously simple conditions, we should not advise a contractor to bid on a lump sum basis unless he were to estimate very liberally for contingencies.

Of course it is possible to get contractors to bid on a lump sum basis, but in the long run, it will be found an expensive plan. It will either drive conservative and careful bidders away, or it will result in higher costs than under unit price bidding.

There are but two ways in which a state can save money by securing lump sum bids: (1) Through getting contractors to assume risks without fully compensating them for the risks. (2) Through preventing skilled contractors from outguessing the engineers as to the ultimate quantities of each class of work.

As we view it, no government should desire to make money at the expense of an individual. Where there are risks, a government should assume them as far as possible. If, therefore, there is uncertainty as to the percentage of rock excavation, the state should not attempt to make a contractor assume the risk.

An unbalanced bid can not ordinarily cause a loss to a state save under one condition, namely a wide difference between the estimated and the actual quantities, which wide difference the contractor foresaw but the engineers did not foresee. In other words, if a contractor can outguess the engineer as to the ultimate quantities, or if the engineer has actually erred in his quantity estimates, the door is open for successful unbalancing of bids. What competent engineer is ordinarily fearful of such a situation?

The common objection to unbalanced bids is entirely different. It is said that an unbalanced bid enables a contractor to put high prices on the work he does first, and thus it becomes possible for him to make an undue profit in the early part of the week. An unscrupulous contractor might thus "skim the cream" and leave his bondsmen to finish the job. If this is a justifiable fear, there is a remedy at hand. Let the contract state explicitly what unit prices will be used by the engineer in estimating the monthly payments to be made to the contractor, only the final payment being estimated at the contractor's unit prices.

The highest ethics is the best economics in the long run. Certainly it is no more than fair that risks be assumed, as far as possible, by the contracting party that is best able to stand a loss in the event of an unforeseen outcome. In the long run, the assumption of risks by a state or municipality will reduce the prices it pays for work done. If engineer's estimates are exceeded when this is the policy, so much the worse for the estimates. These very excesses proclaim the risk and roughly indicate its quantitative amount.

Highway engineers are not in a position to follow the practice of railway engineers in all their dealings with contractors, more is the pity. Railways usually endeavor to hold good contractors by giving them liberal "classification" of excavated materials whenever it is apparent that the contractors are in danger of "going broke." An engineer for a company may do this, but an engineer for the public cannot do so without danger of severe criticism from those who do not perceive the underlying equity and the sound economics of this sort of liberality. But an engineer on public work is not debarred from so drawing specifications and contracts as to relieve contractors of many risks. Indeed it is the part of real wisdom to do so.

A railway engineer is more free to guess roughly as to "classification," etc., for the reason just given. A highway engineer is more bound to big test pits, and drive rods, that his estimated "classification" may be close to the facts.

We have chosen grading as an illustrative item, but the same sort of reasoning applies to many other items. Thus, where gravel or sand are to be used in building the road pavement, it seems very desirable that the engineer determine the sources, the character and the available quantity of these constituents. This is usually left to the contractors to estimate, and introduces another element of uncertainty.

Summing up, we wish to emphasize the desirability of such a complete study of conditions, on the part of the highway engineer, that he may draw specifications and contract so as to reduce the contractor's risk to a minimum. It is also desirable to publish detailed unit costs, not only of work that is very economic but of the most expensive sorts of work as well, stating fully the conditions. We believe, too, in the wisdom of making public the engineer's detailed estimate of projected work. This is one of the most effective guides against extremes of bidding, and it saves many a contractor from "going broke."—Engineering and Contracting.

Trade, Engineering and Scientific Problems

By R. O. Wynne-Roberts, M. Inst. C. E., M. Can. Soc. C. E., F. R. San. Inst., Consulting Engineer, Regina'

IN my review of the Symposium on Trade Possibilities* I referred to the U. S. Bureau of Standards and its relation to commerce. It may be of interest to your readers to know something of what that branch of the U. S. Department of Commerce is doing for the public.

The Bureau of Standards deals almost entirely with scientific and technical problems. The standards which it is authorized to deal with are associated with measurements, values of constants, quality and mechanical performances. These appear at first sight to be more scientific than commercial; yet when the report of the work done in 1914 is perused it will be found that the operations of the Bureau cover an immense field of activities.

Standards of measurements, for example, cover lengths and weights to extremely small fractions, and also great proportions. Constants are in connection with almost every branch of science and industry. Standards of quality are for any given material—steel, cement, oil, paper, cloth, etc. Not only so, but investigations into the causes of the quality of any material

*Contract Record, March 10, 1915.

being good or poor are made so that the manufacturers and users may know them. Standards of the performances of any instrument, device or machine are established for the guidance of the public.

This Bureau, while willing to assist all who are interested, in the solving of various problems, does not compete with commercial laboratories, but merely renders them what help they desire in fixing on tests, etc. It also on request advises public bodies, and acts as arbitrator in cases of disputes on technical matters.

It is as much in the interest of the public as in that of the manufacturers that commercial undertakings should expand, but "it is upon quality, as well as upon price, that competition must finally depend, whether in domestic or foreign commerce."

A few examples of the work done by the Bureau of Standards will be described. Those wishing to know more about the functions and operations of the Bureau can easily write to the Director for a copy of his report, and for technical pamphlets on various investigations.

Methods of testing sieves used for cement screening were systematized; hydration of Portland cement—an important subject to engineers—was investigated; durability of concrete in alkali water was started; high pressure steam test of cement was found to be unreliable; the time of the setting of cement as found by Vicat needles was inquired into, owing to controversies between engineering societies and the Government, a standard specification of Portland cement was discussed with the American Society of Civil Engineers and the American Society for Testing Materials; the effect of sea-water on concrete will be reported upon this year. Water-proofing of concrete and other allied matters were under investigation.

It will be observed by the press that this Bureau is now inquiring into the reason for the slagging of the concrete at the Edison fire.

The bursting of a steam boiler owing to the fusible plug failing to fuse was an important matter under investigation. An inquiry into the efficiency of surface combustion furnace which develops very high temperature with less fuel than ordinary furnaces is under way.

Structural steel column tests are in progress, and the calibration of testing machines and the strengths of material are being examined.

In thermometry, pyrometry and heat measurements most interesting and instructive researches were made. Among them was the interesting inquiry made after the loss of the Titanic into the problem of detecting the proximity of icebergs. The general results were "that the temperature variations in parts of the ocean far removed from ice are often as great and as sudden as in the immediate neighbourhood of icebergs and that it is not possible to draw positive conclusions as to the absence or proximity of ice from the temperature of the sea water. The temperature records may, however, give valuable information and warning of approach to shore or shallow water on the location and identification of characteristic ocean currents, and even of the proximity of ice in some parts of the ocean, distant from commingling ocean currents, where the temperature variations are less sudden and erratic than in the regions where the above observations were made."

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* See Contract Record, March 10th, 1915.

The heat of combution gases was investigated at the request of the American Gas Engineers.

The fire-resisting properties of structural materials serves as an excellent example of the scope of the work of this Bureau. The behaviour under fire of steel and cast-iron columns, insulated and otherwise, is a very important matter to all associated with building operations; and this subject is being investigated in co-operation with the Underwriters' and Mutual laboratories.

In the electrical branch the work comprises many kinds of tests, and among them were studies made to establish correct transformer formulae, and the same for inductance.

Although the foregoing is only an indication of the work undertaken by the Bureau of Standards, it will doubtless suffice to show that its function is a useful one to engineers, manufacturers, merchants and the general public.

Reference was made in the Symposium to clay products as one of the Canadian industries which should be developed. This Bureau undertook to investigate the toughness of paving blocks, the study of white ware glazes, the behaviour of clay in water suspension under the influence of direct electric current, the viscosity of porcelain at kiln temperatures, the plasticity of clays and the effect of dissolved salts upon clay suspension, the suitability of clays for vitreous ware, the drying properties of clays, clay shrinkage, the loading of building tiles, the resisting power of earth in relation to sustaining power of pile foundations, the strength of brick piers, and so on.

Liquid Chlorine and Hypochlorite of Lime

THE following summary is contained in a paper relating to the relative efficiency of liquid chlorine and hypochlorite of lime presented at the last annual meeting of the New Jersey Sanitary Association by Mr. Frank E. Hale, of the New York Department of Water Supply, Gas and Electricity.

1. Intensive study of the application of liquid chlorine and of hypochlorite of lime during the course of three years at Valhalla, N.Y., points to a ratio of 1:7, chlorine to hypochlorite of lime, as productive of equal bacterial purification when hypochlorite of lime is applied under usual conditions. 2. Insufficient attention to details, causing serious loss of available chlorine, is a large factor in the use of hypochlorite of lime, and greatly affects the above ratio. When efficiently used the ratio approaches 1:3. 3. Liquid chlorine is equally efficient whether applied to the water as a gas or in solution. 4. A certain immediate consumption of chlorine takes place, probably dependent on the character of the water treated. This is true with both liquid chlorine and hypochlorite of lime. Liquor chlorine soon disappears entirely from the water whereas residual hypochlorite of lime may persist for weeks. 5. The bactericidal action of chlorine is practically instantaneous. 6. The amount of chlorine treatment should always be based on analysis of the solution with hypochlorite of lime and upon loss in weight of chlorine with liquid chlorine.

I may perhaps in closing best add in concise form the important advantages liquid chlorine has over hypochlorite of lime. 1. Compact installation. 2. Ninety per cent. less storage space required for chemical. 3. No loss of strength of chemical during storage. 4. No sludge problem. 5. No residual hypochlorite in water, hence less corrosive effect, no complaint of odor, and less danger from overdosing. 6. More effective per unit applied. 7. More uniform application. 8. Better and easier regulation. 9. Easier to handle generally and less obnoxious. 10. No increase of hardness in water. 11. Labor cost less and chemical more efficient making total cost about equal.

LETTERS

Canada's Great Clay Resources

Toronto, Ont., March 12, 1915.

Editor Contract Record:

The need for developing our own resources is a matter which has been given considerable attention by contributors to your Symposium.

That we have resources is more apparent than real to not a few who would urge us to produce a certain class of goods or range of ware in some particular line now supplied by the import market. That we have it is apparent, but the speculator has stepped in and said, "No, you cannot develop it until I have had my share."

The following passage from a letter from our Commissioner of Commerce to the writer, anent the encouragement of British clayworkers to come and locate their business in Canada, will throw some light on this side of the matter.

> "It happens that an English firm are now making enquiries with regard to location with a view to starting works in Canada. They state that prices asked for suitable sites are so exorbitant that they have decided to delay proceedings."

That Canada has unlimited resources of valuable clay as yet undiscovered goes without saying. The writer was shown specimens of fire clay with the information that the ground was staked off. It will be interesting to note the development and to see into what channel the mineral will be turned.

It is possible to exploit our resources and depreciate their value by diverting them into channels which bring the least return to the country at large. A few years ago a valuable deposit of Kaolin was opened up by a Montreal company. The intention, in the meantime, seems to be the supplying of paper manufacturers with material for finishing their product. The process of preparing the Kaolin for the market calls for the removal by washing of all impure and foreign material, of which one-fourth is pure silica, which is put out as waste. Less than three-fourths of the amount quarried finds its way to the market. The output of the mine must be low, if only the Canadian market is to be supplied. But as the United States imports large quantities of China clay there will be no difficulty in finding a market for the full output of the mine, which will eventually return to us manufactured into wall tiles, electric fittings, etc.

The direct manufacture of clay products from China clay would also call for the developing of our vast deposits of silica and feldspar for the home market. Instead of three-fourths of a ton being put on the market, the same quantity of clay from the mine when manufactured would produce from two to four tons of clay products of a class that we are importing every day. Our magnesite, feldspars, etc., are being exploited by exportation—to be returned to us again in another form which could be produced in Canada.

Yours truly,
D. M. DUNCAN.

In regard to the statement published in our British Empire Number of February 17th, to the effect that steel bell and spigot pipes for water-works purposes were formerly imported only from Germany, a correspondent points out that the original patentees of the bell and spigot joints on steel pipes were Messrs. Stewarts & Lloyds, Limited, of Glasgow, Scotland. This company has already delivered over seven hundred miles of all sizes of piping, from 2-in. to 72-in., in Canada alone, which is considerably in excess of the quantity of similar pipe which has been imported from Germany.

Will Pioneer Bore Weaken the Rogers Pass Tunnel?

THE Rogers Pass Tunnel, which is now being driven through the Selkirk Mountains in British Columbia, is one of the constructional undertakings of the day. Frequent reference has been made to the work in these columns, but problems are continually arising in connection with it. One of these, which forms the subject of an interesting communication to The Engineering Record from Eugene Lauchli, is: "Will the Pioneer Bore Weaken the Tunnel?" Mr. Lauchli writes:

On account of the magnitude of this enterprise, and more especially the construction method adopted by the contractor, for the purpose of increasing speed in driving, it cannot fail to attract widely the attention of tunnel men. A deep knowledge of the problems involved in such a work is required to try a novel method on a large scale, and the engineering profession will undoubtedly gain valuable information through the completion of this bore.

The double-bore system of tunneling has attracted much attention among European engineers during the past decade, and much has been learned from the experience gained in driving the Simplon tunnel. When the latter project was considered, little information was available to guide the engineers as to the distance to provide centre to centre of bores, and 56 ft. was then considered adequate for the purpose intended. It was thought feasible to drive one bore first to full section and line with masonry, leaving the parallel 6 x 10-ft. heading unlined until conditions of traffic would necessitate its enlargement to a full-size single-track section.

Prof. D. Heim, the noted Swiss geologist, who has devoted much of his time studying mountain formation and especially ground pressure in connection with tunnel work, strongly recommended that the parallel heading be lined at the very outset. His recommendations, together with his theory of ground pressure acting on a bore in a "hydrostatic-like" manner, met with little appreciation from tunnel men, although the valuable experiments of Adams and Nicolson had proved that marble, for instance, could be made plastic under high pressure, and that test specimens had been made to undergo a change of shape without losing any of their original strength.

Heim's theory, which in many instances has proved to be well founded, can be briefly outlined as follows: "Under high pressure, rock in a mountain range or under a peak lies in a state of 'latent plasticity.' When, through the process of tunneling, rock is freed on one or more sides, it endeavors to expand, or acquire its original shape, that is, the shape and volume it occupied before becoming subjected to compression during the period of mountain formation; hence the phenomenon of 'shelling or popping' of rock, during construction of and after driving a bore such as a tunnel, shaft, etc. This expansion or change of volume takes place more or less slowly (a week or several years) according to the material penetrated, its cohesion, also the geological formation of the mountain, the heat prevailing, etc."

As referred to above, little consideration was given to Heim's theory by tunnel men; yet, during the construction of the Simplon tunnel, heavy ground pressure and shelling took place in apparently sound and hard rock, and it became necessary to line certain sections of the parallel heading at the very outset. As years passed, more shelling occurred in the roof, sides and floor of the parallel unlined heading, in certain instances partly choking it with debris, and it became evident that unless the parallel heading be lined at once with masonry, extensive damage would result, this possibly extending to the completed bore. This year, that is, about fourteen years after the completion of the latter bore, intense shelling took place in the parallel heading, and serious lateral movements of the masonry side walls took place in the completed bore; thus the mountain, far from having reached a state of rest, was still exerting its crushing effects.

Shelling of rock in an unlined tunnel means a slow but gradual enlargement of the section, and the larger a bore the more intense becomes the shelling and crushing effects. Shelling of rock usually takes place in solid rock; the phenomenon has taken place in granite, aplite, porphyry, granite-gneiss, diabase, sandstone, quartzite, limestone, dolomite, coal and shale.

In the Leggistein tunnel shelling took place in the roof several years after its completion; the effect would last for a month or two at a time. In the Wattinger tunnel violent shelling took place under the track. In the Tauern tunnel shelling took place at the roof, floor and sidewalls. Shelling has also been observed in the Wocheiner, St. Gothard, Pfaffensprung and many other tunnels penetrating all kinds of formation, but always in solid rock having a sound appearance.

The Rogers Pass and Simplon tunnels present striking resemblance as shown in the accompanying table. From the standpoint of stability the roof of Rogers Pass tunnel, being a double-track bore, is less stable than that of the single-track bore of the Simplon tunnel, and the thrust due to arch action is of course greatest in the first bore. Furthermore, both headings in the Rogers Pass tunnel are driven at the top, or roof, so that the shattering effects due to blasting are more injurious in the latter case. Another disadvantage lies in the fact that the masonry lining in the main bore is not built immediately, so that initial movements of the strata, however small these may be, are not checked at the very outset.

Thus, the question as to the necessity of lining the pioneer bore of the Rogers Pass tunnel becomes an item of vital importance which deserves due consideration from the standpoint of construction and maintenance of both the pioneer and main bores. The unanimous opinion of experienced tunnel engineers and that of geologists who have given this matter due consideration is that the distance centre to centre of bores of a twin tunnel system should be at least two or three times that adopted when driving the Simplon tunnel. Those who have devoted some time to this interesting question will undoubtedly watch with interest the behaviour of the material penetrated by the Rogers Pass tunnel.

Do not oil form work after the steel reinforcement has been placed, if as a result of so doing the oil will come in contact with the metal, as this destroys the bond between concrete and steel.

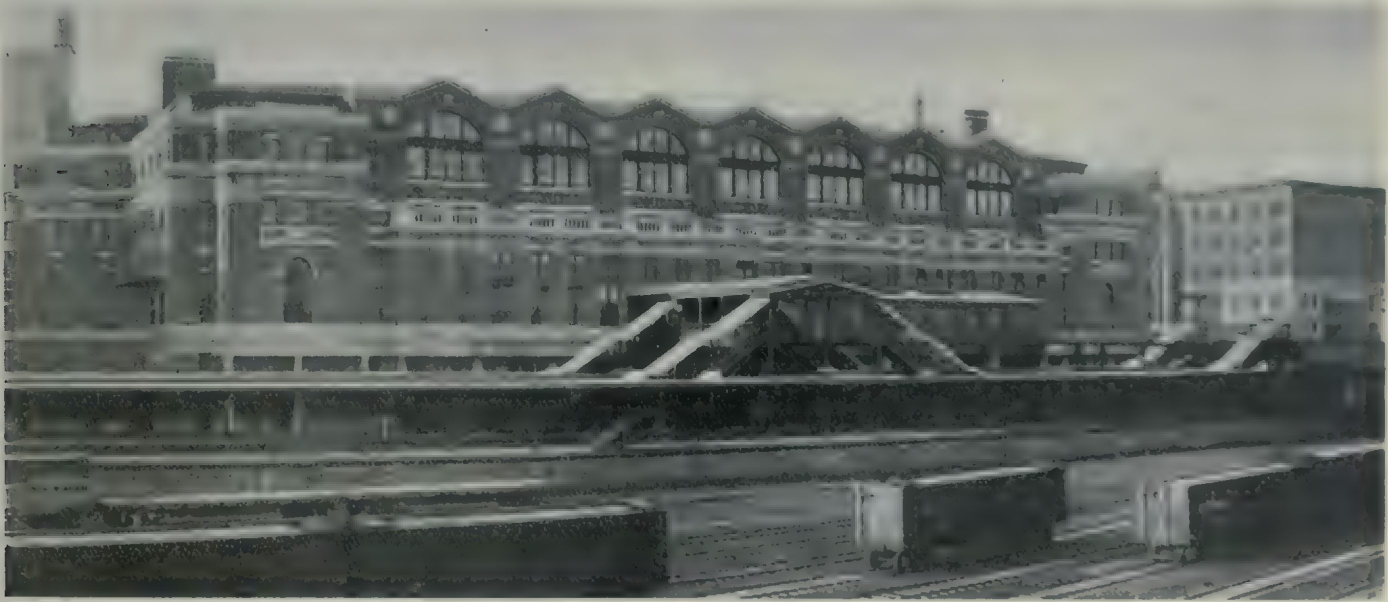
Exterior and Interior Views of the New C.P.R. Passenger Station at Vancouver, B. C.

Terminal Improvements of the Canadian Pacific Railway at Vancouver, B. C.

DUE to the rapid growth of traffic at the Vancouver Terminal of the Canadian Pacific Railway in British Columbia, it became necessary about two years ago to provide increased facilities for handling both passenger and freight business. This rapid growth of traffic has been due very largely to the transcontinental service of the C. P. R., its steamship service between Vancouver and the more important Pacific Coast ports and its trans-Pacific service to and from ports in Japan, China, Australia and the Phillipines. Another element that has served to increase this business has been the various other steamship lines with which the transcontinental trains connect at Vancouver. This interchange of traffic between the railway and steamers as well as between the city of Vancouver and other points necessitated somewhat unusual terminal provisions.

The passenger station is located at the foot of Granville Street, one of the principal thoroughfares in the city. This street has been extended over the passenger and freight tracks to a new steamship pier. To the west at Burrard Street another viaduct has been constructed over the tracks to afford access to the steamship pier used for trans-Pacific service, built in 1908 and since extended out to the harbor line. This extension was made to provide for the larger steamships which were put into service within the last two years. The site of the old passenger station was directly at the foot of Granville Street and the only means of access to the steamship piers before the improvements were made was by way of a grade crossing to the west of the old station. This grade crossing naturally was a source of danger and delay and in the new plan the freight yard was re-arranged with connections to reach the present steamship piers as well as those which might be constructed at some time in the future when business required.

The passenger track lay-out provides four through tracks raised about five feet above the old grade in order to reduce somewhat the vertical distance between the street level and the track level. Provision has been made for an extension of the trackage by leaving room for additional passenger tracks to the north over the site occupied by freight tracks. The station build-



Rear View of the New C.P.R. Station, showing lay out of Tracks, Covered Platforms and Viaduct.

ing facilities are adequate to serve several times the number of passenger tracks built under the present plan.

Granville and Cordova Streets were about 35 ft. above the old level of the tracks. Under the new scheme these streets are about 30 ft. above the track level. This condition necessitated the use of a two-level station with the principal public rooms on the street floor and railway facilities for baggage, express, etc., on the track level below. The plan also lends itself to providing a convenient means of access to the train platforms and shelters by a bridge over the tracks. Independent exits are provided so that passengers may go directly to the street without passing through the station. Electrically-operated baggage lifts are provided by which baggage may be raised from the platform level to the extension of Granville Street and thence carried to the steamship pier. On the street level of the station are the general waiting room, ticket offices, lunch room, women's waiting room, smoking room and baggage checking room, all conveniently located with relation to each other and with generous allowance for lobbies and corridors. On this floor also are the principal entrances to the C. P. R. offices, which are located on the upper floors. The general waiting room is 212 by 56 ft., including the east and west lobbies, each of which measures 46 by 28 ft. The women's waiting room and the smoking room are each 46 by 36 ft. On this floor also are located the lunch room and its service pantry. The kitchen and refrigerating rooms are placed on a mezzanine floor below the street level. On the track floor are the baggage, mail and express rooms, also rooms for Canadian and United States Customs, warerooms for the News and Dining Car departments, and the power plant. Steam is generated for heating the station and cars and other service facilities are provided. Between the station building and Cordova Street at the lower level is a large paved area used for baggage, mail and express trucks. Access to this area from Cordova Street is had by a ramp descending by easy grades to the west of the station building.

The passenger station is a steel frame structure with pressed brick exterior walls and Indiana limestone trim. The main facade of the building consists of a colonnade of ten free standing Ionic columns, 35 ft. high, symmetrically flanked by pavilions or end wings. The track facade of the building is expressed by a series of large arched openings and occupies a very conspicuous position when viewed from the harbor. The main waiting room is located immediately behind the colonnade and is approached by vaulted corridors from either end of the building. Ionic pilasters and engaged columns are used for the decoration of the walls of this room. These columns are of artificial Caen stone with wall tinted to match the stone work. The floors are of terrazzo figured with a design panelled to match the arrangement of seats and wall columns. The ceiling is forty feet above the floor and of heavy beam and panel design. Illumination is by means of incandescent electric lamps, the ornamental ceiling fixtures and wall torches of special design being of cast bronze. The seats in the waiting room and woodwork around the ticket office are of oak. The smaller waiting rooms, dining room, etc., are treated in a very simple manner with oak wainscoting, plaster walls and plain panel ceiling.

The new C.P.R. Station at Vancouver under Construction.

Above the ground floor are three floors devoted to offices for the use of the railway company. A large interior court affords natural lighting for the general waiting room and also for the interior office rooms. These offices are finished in natural wood with maple floors. Four passenger elevators serve the office quarters and the lower mezzanine and track level floors.

The service plant, located on the track level floor, has a capacity of 450 h.p. The boilers are of the horizontal return tubular type, designed for oil fuel, and supply steam for the forced circulation hot water heating system in the railway station, also for passenger and freight car heating and for the steamship passenger station which is heated by a direct steam system. A 12-ton refrigerating plant provides service for the lunch room and kitchen.

Alternating current, purchased from the public service company, is transformed and distributed throughout the terminal for electric lighting and for the operation of the elevators in the building and on the track level.

Ventilation of the kitchen is accomplished by means of a supply and exhaust fan system. All toilet rooms are provided with an exhaust sytsem. Vitreous china and porcelain plumbing fixtures are used throughout.

For fire protection the two lower floors of the building have a sprinkler system. The upper floors are served by standpipes and fire hose.

A vacuum-cleaning system consisting of a six-sweeper low suction machine, operated by a direct connected motor, serves all parts of the building above the track level.

Two tracks are provided for inbound passenger trains and two tracks for outbound passenger trains with separate platforms. There is a platform adjoining the station used for baggage, mail and express only. While Vancouver is the end of the line, the station is arranged as a through station in order to get the best use of the tracks and avoid blocking the approaches when trains are backed out preparatory to shifting to the storage yards. Incoming trains proceed westward and back out over the thoroughfare in the freight yard, leaving the station tracks clear of all shifting movements.

The extension of Granville Street by a viaduct over the tracks affords access to the upper level of the new steamship pier. This viaduct is 80 ft. in width and is enlarged in front of the pier station to provide a plaza for public and private vehicles. Baggage and freight is received at the pier on the lower level to which access is had by ramps leading from Granville Street and Burrard Street viaducts.

The substructure of the pier is built largely of creosoted timber and presents a number of unusual features. Sea worms, the teredo navalis, are very active in the waters of Burrard Inlet, and untreated timber cannot safely be used for more than two years where called upon to bear heavy loads. The depth of water at high tide at the outer end of the pier prior to construction was over 60 ft. with a soft bottom, necessitating very long piles. The harbor was filled in at the site of the pier as high as practicable so as not to interfere with the draught of vessels which would use the pier, and the piling was then driven through the filling. About 3,000 piles—ranging in length from 80 to 110 feet—were driven in the substratum. The substructure of the pier is well braced above the low water line and the filling adds additional stiffness to the entire structure. Fenders of large logs chained together afford extra protection to the pier and distribute evenly throughout the structure any shock which may occur from a vessel striking the pier. A railway track, depressed so as to bring the floor of the cars about level with the pier floor, is carried through the centre of the pier. The decking of the pier is of Australian hardwood, which has been found to give better wearing results with the class of traffic and atmospheric conditions existing in Vancouver.

The superstructure is of slow-burning timber frame construction, covered with wood sheathing. The interior trim in the public rooms on the upper floor is of Douglas fir, finished to show the natural grain and beauty of the wood, the exposed roof trusses in the main waiting room being dressed and chamfered. The waiting room is 83 by 96 ft. A ladies' waiting room, a smoking room and rooms for the Immigration and Customs departments of Canada and the United States have been provided. There is a promenade overlooking the harbor, reached from the waiting room, on the outer end of the pier over the one-storey freight structure. As one enters from the plaza the ticket office, parcel room and baggage checking room are conveniently reached on the concourse leading to the main waiting room.

Access to the steamships from the upper level is afforded by means of ramps leading from the concourse on easy grades to the landing on which the gang planks are placed. The landing is adjustable for different stages of the tide which has a range of about 16 ft. Passengers coming from the steamships use the ramps and go through the customs examining rooms, or, where examination is not necessary, they may be diverted directly into the concourse. On the lower level, which is used for baggage, express and freight, there are provided electrically-operated lifts on each side of the pier to meet the vessel ports. These lifts are adjustable and may be used as sloping gangways, or they may be raised and lowered similarly to an elevator and are 10 by 48 ft. in area, holding several trucks.

Certain additional facilities were provided for the terminal. Among these is a building for the Dining and Sleeping Car Department which is completely equipped with facilities for storage and distribution of supplies, a bakery and kitchen, refrigerating apparatus, rest rooms and offices for conductors, porters and other employees. The building is a two-storey structure with brick walls and heavy timber interior frame with laminated floors. The building is located conveniently to the passenger car yards where the cars are cleaned and overhauled between service periods on the road.

The general designs and layout of the entire work were prepared, terminal buildings constructed, and equipment installed by Messrs. Westinghouse, Church, Kerr & Company, Montreal and New York, under the general direction of the Engineering Department of the Canadian Pacific Railway (Mr. J. G. Sullivan, Chief Engineer).

The architects for the Passenger Station building were Messrs. Barott, Blackader & Webster, of Montreal.

Work was begun early in 1912, and the station and pier were opened to the public in July, 1914.

When using wheelbarrows as a unit of measure, they should be brought to a level when filled; a small top on the wheelbarrow load looks like a small matter, but may in fact mean a material decrease in the proportional amount of cement. Wheelbarrows containing the required amount when level full can easily be obtained. Bottomless boxes made to set in the wheelbarrow can also be used to measure the materials correctly.

Weight of street dirt in Chicago per cubic yard, wet and dry, was recently obtained on different kinds of pavement by the Bureau of Streets. From an asphalt pavement dry sweepings weighed 806 lbs., and wet sweepings 1,252 lbs Corresponding figures for other types are: Brick, 1,015 and 1,425 lbs.; granite blocks, 1,100 and 1,503 lbs.; oiled macadam, 1,330 and 2,040 lbs.

Concrete Construction in Stands, Stadia and Bowls*

By Charles W. Leavitt, Consulting Engineer, New York

Mr. Charles W. Leavitt.

We of to-day prefer not to make large and unnecessary expenditures on public and semi-public structures. Also, because of the limited area which they inclose, the modern stadia and bowls are limited as to the performances which can take place within them. Neither Yale, Harvard nor Princeton can hold baseball games within their stadia. The stand is the result of the demand for cheaper construction and suitable accommodations for the immense crowds that wish to see sporting events requiring larger fields. The American public insists that its stands be models of safety, durability and economy, and that they provide for each spectator a good, clear view of the performance. The steel stand, placed on the sides of the field of sports, was built to meet this demand in all its phases. Not always in economy of construction, but frequently in cost of maintenance, it compares unfavorably with the stand or stadium of reinforced concrete, but the size of the stand would seem to be limited only by the length of vision of the human eye and the view afforded to the spectator seated at the greatest distance from the scene of action. The requirements of each particular case must determine the kind of material to be used for construction.

In 1904 I designed and built the racing plant at Belmont Park, Queens, N.Y., and constructed upon the grounds a steel stand which is the largest racing stand in this country, if not in the world. Although the actual seating capacity of the main stand is but twelve thousand, the provision for spectators in the aisles, around the betting-ring, on the lawns, etc., easily brings the total of spectators crowding the stand up to forty thousand. There are three tracks at Belmont Park, occupying in all a space of about thirty-five hundred by fifteen hundred feet. The stand is placed at one side and is about seven hundred and fifty feet in length and about one hundred feet in depth. There is space for a one-hundred-and-fifty-foot extension. Because of the length of the sporting area to be covered, this shape of stand is essential. The structure has proved to be of a stability and durability equal to the immense strain put upon it by the crowds that thronged Belmont Park when horse-racing was at its height in New York State, the attendance having been as high as sixty thousand at one time.

The "Pirates," in Pittsburgh, have at Forbes Field a steel stand which I built for them in 1909. The actual seating capacity of this stand is thirty thousand, and it is built around two sides of the baseball diamond. To facilitate handling the large crowds in the aisles, I originated and designed with this stand the use of an incline instead of steps, and have found that this not only serves to empty the stand more quickly after a game, but also, in other stands which are not covered as this is, aids materially in drying after a storm.

The use of concrete for stand and stadium construction began in the early history of building. The Coliseum is a combination of concrete with other materials. The concrete stand, stadium or bowl reinforced with steel presents to-day, in a great many cases, the best solution of the problems of economy, stability and durability which are before us in this connection. It usually is cheaper than all steel, is not so liable to decay, is more stable than steel and involves a minimum cost of maintenance. Not much has been done in recent improvement or invention along this line, although the chemistry of the cement has been perfected. One of the engineers in my office has remodelled an existing set of formulae and, by substitution, has simplified very materially the method of computing the design of concrete members under flexure.

During the last year I designed and built the athletic field at Lehigh University, South Bethlehem, Pennsylvania. The topography of the land there is such that it was found best to arrange the entire field on two terraces, with a drop of thirty-three feet between them. The upper plateau contains the practice-field, running tracks, buildings and parking space; the lower plateau contains the stadium, including the gridiron and baseball diamond. This field is about six hundred feet by two hundred. The structure, when completed, will enclose the field entirely on two sides, and partly on two other sides, leaving one corner open. It is of reinforced concrete, and, along the side adjacent to the upper field, the seats are placed directly on the cut made by excavation, much as in the construction of a bowl. On the other three sides concrete supports are used. The seating capacity of the finished structure will be fifteen thousand, with standing room for five thousand more. A novel and efficacious method of draining the seats and aisles is provided here by a wash of one-eighth of an inch to the foot from the centre of the seat to the aisle, the water then being carried away down the aisle. This is so effectual that half an hour after a heavy rain the seats are quite dry and ready for use without inconvenience.

Up to this time modern stadia have not been praised generally for their decorative art, as is the Coliseum, although those built lately compare favorably with the descriptions of the ancient structures; their great size gives them dignity and makes them impressive. We have scarcely come to the point of placing gardens and trees on the tops of the walls, as on the Arena built by Napoleon at Milan, since we have found that even that space must be used for seats and standing room; but the general lines of the Syracuse Stadium, the Lehigh Stadium, many of those of the universities of the west, the Harvard Stadium and the bowls at Yale and Princeton, etc., will stand comparison with others of the kind which have gone before.

As to size, the Yale Bowl has an outside measurement of nine hundred and thirty feet by seven hundred and fifty, and an inside measurement of five hundred feet by three hundred. The Coliseum has an outside measurement of six hundred and seventeen feet by five hundred and twelve, and an inside measurement of two hundred and eighty-two feet by one hundred and seventy-seven. While the Yale bowl now handles a crowd of about seventy thousand, it can, by the construction of another deck of seats—as has been done at the New York Polo Grounds—be so enlarged as to accommodate one hundred thousand spectators with expedition and safety. From present indications, it looks as though this would have to be done in a short time.

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*Paper presented at the Eleventh Annual Convention of the American Concrete Institute.

In the placement of the Yale Bowl about half underground, there appeared an entirely new note in the construction of stadia. The vertical distance from the gridiron to the top of the wall back of the seats is fifty-four feet, and of this distance just about half is below the level of the adjoining land. The advantages of this arrangement are largely in stability, economy of construction and ease of maintenance. Exits to the ground are reached by steps, and also by tunnels to the surrounding buildings.

The shape of college stadia and bowls is usually elliptical, with the seats either partly or completely surrounding the field. That of stands has usually been straight along the sides of the field. At Belmont Park, and at other race-tracks, the stands have been placed at a small angle to the straight line of the outside track, and they have been found to be most satisfactory.

There are many ways to use concrete in stands, stadia and bowls. In the stand at the Empire City Track, at Yonkers, N.Y., I put two and one-half inches of concrete upon corrugated iron, for treads. This made a very satisfactory floor and was the only concrete used in the stand, with the exception of that used in the foundations and pavement. The stand was built in 1899 and is in good condition to-day. At Belmont Park very much the same use was made of concrete, although the iron was covered to a somewhat greater extent. At Pittsburgh, on the stand at Forbes Field, concrete was used in the same manner, but the bleachers were constructed entirely of reinforced concrete, no steel being used excepting for the reinforcement of the concrete and for the standards for the seats.

One of the greatest fields for the use of stands is at fair grounds. As a rule, these stands have been of steel. Reinforced concrete, no doubt, will come into use for the seating decks, but I do not believe that it ever will prove practicable to make the roofs of any material other than wood or steel. Stands at fairs must be of great seating capacity, as they are used more as a seating area than as a shelter for a moving crowd, such as attend races. It may be that some form of reinforced roof can be devised that will cover at least a portion of these stands and give satisfaction.

This leads up to the demand which is coming for a stand from which air craft may be viewed. A portion of the roof, if not all of it, will be done away with, making it possible to get an entire structure of reinforced concrete at a reasonable cost, with a treatment which is ornamental and not too heavy.

Also, the demand has come, at automobile races, for stands holding about one hundred thousand people. This problem, as yet, has not been worked out satisfactorily, and will probably result in a combination of the stand with a stadium or bowl treatment, since the requirement is for a structure combining the different elements of all three kinds of schemes. In the construction of these stands it is not necessary to put so much emphasis on their permanency as is the custom with the other structures, since it seems to be recognized that automobile racing is rather a passing fancy and may not endure. In fact, the tracks frequently are laid out in the suburbs of cities, with the intention of destroying them when it is possible to dispose of the land for the building of dwellings.

The old grass-stepped banks from which many of the English sports have been witnessed was the source of the idea of the bowl, and it seems to me to have possibilities of further development, as the tendency is to simplify as much as possible the arrangements for witnessing our games and to reduce the cost per seat. Reinforced concrete seems to be the best medium for doing this, and the problem now is to make a suitable foundation that will permit of a minimum amount of concrete being used.

As to shape, materials of construction, drainage and provision for maintenance, I feel that modern engineering has proved equal to coping with every situation which may arise in the matter of stands, stadia and bowls; but I still feel that it is needful to solve the problem of dealing with the unlimited crowds at sporting events. There should be provided some place where as many people as wish it may see a performance in the open with ease and no danger to life or limb. Transportation is working out its problem of crowds, and in the meantime we are struggling into over-crowded elevated, surface and subway trains. Until the problems which I have been discussing are solved, we shall continue to be pushed and crowded at athletic events in the open.

Replacing a 100-ft. Steel Bridge Span in Five Hours

A single-deck of the Second Avenue bridge, carrying the Third Avenue elevated-railway line over the Harlem River, New York City, was lifted on scows by tide action, towed out of the way, and replaced by a new double-deck span, all between 2 and 7 a.m. on Monday, February 22. Both were through Pratt-truss bridges with pin connections. The span length is 101 ft. 10½ ins. The trusses of the new bridge are 26 ft. c. to c. at the north end and 40 ft. 11⅜ ins. c. to c. at the south. The difference is due to a spread of track on account of a switch placed on the bridge. The total weight of span and floor system is 375 tons.

The new bridge had been erected on pile falsework along the river bank, near the bridge site. On the tide preceding the one used in removing the old span, the new structure was taken on two 28½ x 92-ft. scows which were slipped under the span through openings left in the falsework. As the tide rose, the span was picked up on framed bents erected on the scows. The span thus floated was then towed to a point near the bridge site. On the following tide two scows were floated under the old span and a half-hour before traffic was stopped (2 a.m. on February 22) blocking was started. In addition to utilizing the rise of the tide, hydraulic jacks were used, to save time.

As soon as the old span was towed out of the way, the scows carrying the new one were floated into position. Before the new span was lowered the old shoes and expansion rollers were replaced by new sets. The new span was steadied by tackle and was lowered by means of sand jacks, six to a scow.—Engineering News.

The Varying Requirements of Mechanical Plant for Handling Concrete*

By W. P. Anderson†

MECHANICAL plant for handling concrete varies with the character and extent of the work and the conditions at the site. In this article I propose to outline some of the methods used in the construction of reinforced concrete buildings.

It should be borne in mind that in work of this class the opportunity for extensive labor-saving devices is not as great as in work where greater masses of concrete are handled.

There are two classes of equipment which can be used in a mechanical plant for handling concrete. One class—that which is standard, and which can be used on nearly every job—consists of mixers, hoists, charging and placing barrows and similar equipment. For this class of equipment the contractor need never hesitate to buy the best in the market, as it can be used over and over again and is always a good asset. The second class covers that which can only be used in special cases, such as unloading devices, industrial track and cars, cableways and other special machinery. The contractor should be very careful before investing in the latter form of equipment, as in many cases, unless the character of work which he is doing is such that this special equipment can be used on succeeding jobs, its cost will more than make up for the saving in labor gained by its use. This is particularly the case in reference to large elevated hoppers for holding the concrete aggregate, as the salvage from these hoppers at the end of the job is small compared to their total cost, and unless the job is a very large one the saving in labor does not equal the expense of installing the hoppers and the necessary extra equipment needed when they are used.

Method Generally Followed

A common method of handling concrete on a building is as follows: The material comes to the building either by wagon or on cars. The cement is stored in a shed built for that purpose, and the sand and stone are unloaded directly on the ground as near to the mixer as possible. If the building has a cellar below the level on which the material is stored, the mixer is placed in this cellar and a charging hopper is placed above the mixer with a platform around its top, on or slightly below the level of the ground where the material is stored. The aggregate will be taken from the storage pile by buggies to the charging hopper, and after the concrete is mixed it will be hoisted and dumped into a distributing hopper, above the floor being concreted, from which point it will be taken by buggies or chutes to the place where it is to be used.

Conditions arise at times when certain modifications of this scheme can be used to advantage. There is a tendency sometimes, however, to put in too much equipment, and the contractor will find that the saving in labor does not equal the cost of special equipment. The contractor must also take into consideration that in putting in elaborate equipment he is put to this expense at the start of the job, while the labor cost which it replaced is distributed over the entire length of the job and therefore it requires more money to carry on a job with elaborate equipment.

Cars to Mixers Direct

Where material is delivered to the site of a building by rail and the mixing plant can be conveniently located near the switch, it will often be found a great advantage on a job to handle the aggregate directly from the cars to the mixers without storage. Where this is done it is well to store some of the aggregate for emergencies. A convenient arrangement of the plant for this purpose is to build bins along the unloading switch. These bins need consist of only one partition about 2 ft. away from the edge of the car, with the top of the partition brought up to the height of the floor of a freight car. A division partition in the opposite direction should run out about 10 ft., to separate the fine and the coarse aggregate. A platform about 6 ft. wide should be built at the top of the bin, the planks on the platform not being nailed, so that when it is desired to unload directly into the bins it can be done by moving the planks over to the edge of the platform. The platform should run, preferably, with a downward grade, to the mixing plant. When this arrangement is followed it is difficult to avoid having some demurrage on cars, but it saves rehandling of material, and in a number of cases this saving is greater than the extra charge incurred for demurrage. On a very large job it may pay to build two overhead charging hoppers, one for sand and one for stone, and have these so located that the material can be dumped by gravity directly into the mixing hopper. The mixing hopper can be so constructed that it will have sufficient sand for a charge when it is filled to a certain height. Then the stone can be added to another height and after the cement is added the charge will be ready for the mixer, into which it will be dumped by gravity. Where this arrangement is used, a derrick may be placed in such a manner that material can be unloaded directly from cars to the storage hoppers by clam shell or similar equipment, which can also be used for unloading into a storage pile on the ground, as it would be inadvisable to build the storage hoppers sufficiently large to provide for all the material required. As a general thing, however, it would be possible to locate the unloading derrick in such a position that material could be taken direct from the cars to the storage hopper, from the cars to the storage pile, or from the storage pile to the storage hopper. In either of the above plans the object is to handle as much material as possible directly from cars to storage hopper or mixer without a double handling.

In unloading material from cars where the above arrangement is not practicable, it is sometimes found advantageous to have a hopper which can be fastened to the side of a car, so that material can be shovelled from the car directly into the hopper. The advantage of this is that no time is lost in shovelling from the car, and also that more trips can be made in hauling material from the car, as there is no long wait during loading.

In our work we have found that where a level run can be used, a two-wheel buggy, holding 4 cu. ft., is the most convenient form of equipment for getting the aggregate from the storage piles to the mixing plant. Where wheeling is bad, an end-dumping 3-cubic foot wheelbarrow can be used to better advantage. These barrows are used as a gauge for measuring material. In some cases, however, where material comes in by rail and the switch is over 200 ft. from the mixing plant, it will be found advantageous to transport the aggregate from the switch to the mixer by industrial tracks and small side-dumping cars. Where conditions are such that the mixer cannot be placed low enough to have the cars dumped directly into the hopper above the mixer, without elevation, cars can be brought up an incline to the desired point and thus dumped directly into the charging hopper. Where this is done, the cars can be hauled up this track by the same engine which operates the mixer and the rest of the track can be graded so that the cars operate by gravity.

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On one job in the writer's experience, where double tracks were to run into the building after it was completed, it was found practical to place the mixer at the end of these tracks. As soon as the concrete had been finished to the point where the tracks were to go, the latter were put in place and cars were backed up within 10 ft. of the mixer. A small 6-in. I-beam track was placed above the centre line of each car. This track ran to a point above the charging hopper, which emptied directly into the mixer. A scraper, similar to an ordinary dirt scraper, was used for conveying the material from the car to the charging hopper. A steel cable was attached to this scraper and passed over an 8-in. sheave, attached to an overhead traveller which ran on the I-beam track. The cable ran along the line of the track, and was attached to an extra drum on the hoisting engine. The traveller was about 18-in. long and extended about 4 ft. below the track. On this lower portion was a catch to hold the scraper when the traveller was in motion. A lever released this catch, allowing the scraper to drop and at the same time lock the traveller to prevent it from sliding back towards the mixer. The locking device was not sufficient to prevent this from sliding entirely, and a rope was used to hold the traveller in position while loading the scraper. The I-beam tracks were long enough to unload two cars on each track without switching, and as we were able to have cars switched morning and noon we could unload eight cars of aggregate per day. On this job there was practically no room for storage of aggregate and it was handled directly from car to mixer. The I-beam tracks were inclined, so that the empty scrapers returned to the car by gravity.

Location of Mixing Plant

The location of the mixing plant on any job is determined by two factors: first, depending on the ease of getting the materials of which the concrete is composed delivered near the plant; second, the position of the plant relative to distributing the concrete to all parts of the work with as little labor as possible. A mechanical mixer is essential on all jobs of any magnitude. A batch mixer is most commonly used for reinforced concrete work. We find what is known as a 4-bag mixer the most convenient size for general work.

It is often necessary to place some of the concrete footings before the mixing plant can be permanently located for the building construction. In a number of cases it will be found as cheap to do this preliminary concrete work by hand as in any other manner. Therefore, when the mixer is finally set up it is generally in a permanent position for mixing the concrete for the job in question.

In nearly all cases it will pay to arrange the mixing plant so that the cement and aggregate can be dumped into a charging hopper, which allows a complete charge to be dumped into the mixer at one time. This saves time, as while the mixer is mixing one charge another charge can be prepared. In laying out this plant it is much the best to have this charging hopper stationary and above the mixer, so that the charge can go directly into the mixer without being elevated. It will often be found cheaper in the end to dig a hole in which to place a mixer rather than to use any elevating machinery; however, in some cases, where the work is not extensive enough to warrant this expense, some form of hopper can be used into which the material can be dumped, lifted and dumped into the mixer. Mixers are sold with attachments of this kind which can be used when desired.

Another satisfactory arrangement of plant, where the mixer cannot be charged by gravity without elevating the aggregate, is to have a bucket hoist adjacent and similar to the concrete hoist. The charge is dumped dry into this bucket, elevated and dumped into a stationary charging hopper, and from there goes by gravity to the mixer. This method has the advantage of having two charges ready ahead of the mixer. The same engineer and engine on the regular hoist can be used here.

The hoist we have adopted for our work on ordinary buildings is a bucket hoist with a frame tower, with lumber cut to standard sizes, so that it can be used on any job. The concrete dumps directly from the mixer into the bucket and is lifted and dumped into the distributing hopper. This hopper is raised to the desired height on the tower by a block and fall. We usually take concrete from this hopper either by 2-wheel buggies containing about 6 cu. ft. or by concrete chutes. The runways for these buggies are formed by 2 x 12 planks raised on small trestles about 1 ft. high, which keep the runway above the steel reinforcement. The hopper is kept at sufficient height so that the buggies can get underneath the chute at its lower end.

Where the building covers a good deal of ground, it is often found convenient to chute the concrete from the main hoist to various portions of the work, and in some cases to re-elevate and re-chute. The angle of the chutes depend somewhat on the character of the concrete and of the aggregate of which it is composed. We have found that a convenient slope is 1 ft. vertical to 4 ft. horizontal. Where wire ropes are used to suspend the cable, the ropes should be drawn as taut as possible, so that the inclination of the slope of the chutes will not vary when the concrete starts to flow through them. A convenient way of drawing this rope taut is to stretch the rope as tightly as convenient and then attach another rope to it and pull down on the other rope. Another convenient method of handling chutes is to have a boom attached to the concrete hoist. We have found a convenient arrangement for this is to have chutes about 34 ft. long, one end of the chute being attached to the bottom of the hopper at the top of the hoist, with gate to allow concrete to run into the chute as desired. The other end of the chute is held by a line attached to the boom above that end of the chute, the boom being a split-boom so designed as to allow the chute to pass through it. Another chute of the same length can be attached to the lower end of the first chute and concrete from the first chute dumped into the second, the lower end of the second chute being held above the floor on which concrete work is being done by a light A-frame made of wood. The boom should extend 10 or 12 ft. beyond the point where the first chute is attached and a block and fall run from the end of the boom to a point on the second chute 5 or 6 feet from its lower end. Then when it is desired to move the second chute this end can be raised by the block and fall and swung to a new position. It will be found that this will hardly answer for the purpose of holding the chute when concreting, so that the A-frame under the lower end will be necessary, and the block and fall is only used for the purpose of changing the position of the chute. A small chute 10 or 12 ft. long, moved by hand, can distribute the concrete from the end of the second chute. Of course, in chuting in this manner, the distance the concrete can be taken is limited, but we have found it a very satisfactory method where the distances are not too great. Very often it is found advisable to chute the concrete to certain points on a job and wheel from these points to the position where the concrete is used.

Another method of handling concrete on buildings is the use of large derricks and bottom-dumping buckets. We tried this method on several jobs, using two 80-ft. boom derricks, which were placed on wooden towers adjacent to the buildings, the towers being high enough to allow the boom to clear the roof, so that the derricks were not moved after being placed until the job was completed. The buckets were large enough to receive one charge direct from the mixer, and the concrete was dumped, in most cases, directly on the forms where used; otherwise, where the derrick would not reach, the concrete was dumped into a hopper and from there wheeled to place. These booms could also be used for hoisting form work, steel and other building material. The disadvantage of this form of plant is that its use is limited, because it requires room for placing and operating the derrick, which is not always available; also, in congested districts, it is often impossible to guy the derrick. The cost of placing and removing the derrick is so great that it can only be used economically on large jobs. Therefore, as the first cost of this form of equipment is rather great, and its use is restricted, it is not recommended for general use.

Liquid Chlorine Sterilization of the Water Supply of St. Catharines, Ont.

THE city of St. Catharines, Ont., situated in the Niagara Peninsula between Lakes Erie and Ontario, since 1878 has obtained its water supply from the Welland Canal (the connecting waterway between the two lakes), and up to recent years the water has been of excellent quality. However, the rapidly increasing population of the district adjoining the waterway, together with the added amount of navigation through the canal, has naturally created a corresponding possible pollution. In 1912, when it was decided by the Dominion Government to proceed with the construction of the Ship Canal by enlarging portions of the existing canal to accommodate vessels of 10,000 tons, it was realized by the Water Works Commission that steps should be taken to protect the community from possible epidemics arising from the pollution of the water supply, not alone from the actual operations entailed in the necessarily extensive works, but also from the large number of employees engaged, the majority of whom have little knowledge (and care less) of the laws of sanitation.

The writer in his annual report of 1913 again forcefully reminded the commission of the necessity of immediate action, the analysis showing frequent pollution, presence of B. Coli, and notice was issued advising consumers to boil all water before drinking. Action was taken by the commission on the report in January, 1914, the superintendent being directed to investigate the merits of the different methods of sterilization and report thereon, and he was authorized to visit a number of waterworks plants so equipped in the adjoining states.

Being quite familiar with the several types of equipments for the use of hypochlorite of lime and the results obtained therefrom, the principal consideration given to this method was the obtaining of plans and prices for an automatically operated plant suitable to the local conditions.

The ultra violet ray method was also considered carefully, all available data being obtained and studied. Owing to the fact that the local water supply is not a filtered one, and at times is slightly turbid and rather high in organic content, it was felt that although the commission has available a large block of electric power "free" the general conditions were not suitable for the ultra violet method of treatment, and bids for this type of equipment were not asked for.

Liquid chlorine was given very careful consideration, as to its qualities, cost, results, etc., and the different types of apparatus for its application and control were inspected by visiting a number of plants which were in operation and by obtaining all possible data thereon.

Having in the meantime secured prices on the different apparatus, the writer first submitted his report to the Provincial Board of Health and received the approval of that body for the proposed installation and presented the report to the commission on March 31, 1914, recommending the installation of a liquid chlorine plant for the sterilization of the supply. He further recommended the acceptance of the proposition of the Electro Bleaching Gas Company, of New York, including a 36-in. Venturi meter and complete automatic apparatus for the control and regulation of the liquid chlorine; the company guaranteeing the efficiency and accuracy of the whole apparatus and furnishing a guarantee bond covering the agreement.

The report and recommendation was adopted by the commission, and authority was given to execute a contract for the apparatus and to proceed with the work outlined as necessary for the installation.

Active work on the excavation for the concrete meter and valve chamber was commenced on May 26,

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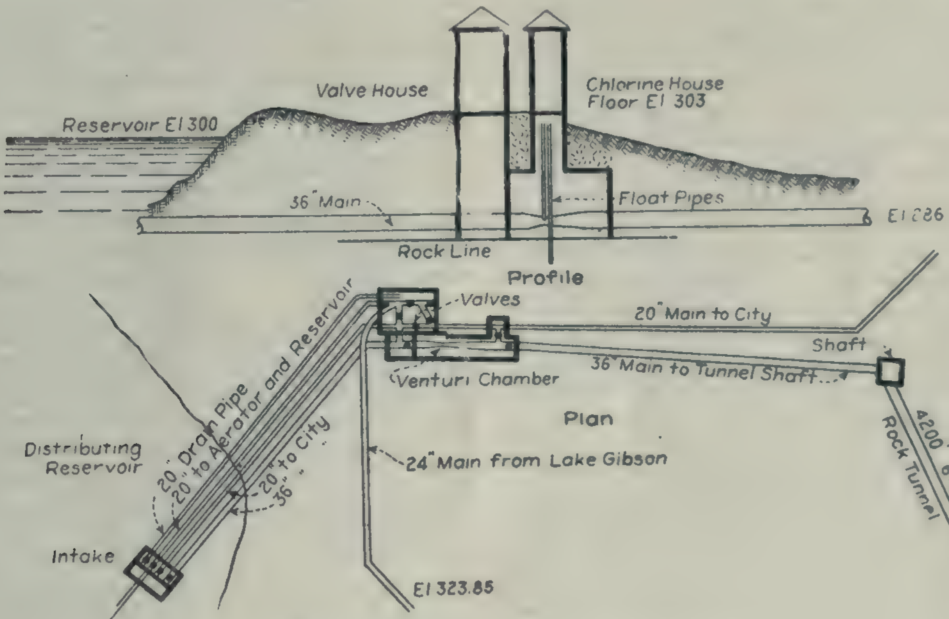
* By Alexander Milne (Superintendent of Water-Works, St. Catherines; Past President, American Water-Works Association) in Engineering and Contracting.

the work being done by day labor under the writer's supervision, the excavation at this point being 16 ft. to 20 ft. deep. The work of setting the 36-in. meter tube involved cutting out and removal of four lengths of 36-in. pipe, placing the 36-in. valve and providing the 36-in. x 20-in. by-pass with 20-in. valve as shown in Fig. 1, the 20-in. connection being made with an A. P. Smith No. 2 tapping machine, without interruption of the supply.

All concrete was of 1:6 mixture, using clean, sharp pit gravel, mixed wet, and liberal quantities of clean, sharp angled limestone spawls. The cross walls of the chlorine house are primarily supported on steel beams, resting on the chamber walls, the whole being continued as a unit up to elevation 303 (local datum) as shown on profile of Fig. 1. The concrete floor of the chlorine house and the roof of the chamber are reinforced with 4-in. (65-lb.) steel rails and expanded metal.

The superstructure is of double-hollow concrete blocks, strapped on the interior and lined with "Beaver Board," the whole being finished in harmonious colors. Power, light and heat for the plant is obtained from 120-volt, 66-cycle current, of which the commission has 500 h.p. "free" from the Power Company whose plant adjoins the works of the commission.



Plan and profile of buildings and piping for liquid chlorine plant.

The general design of piping and valves at the intake crib and valve house is as shown in Fig. 1 and furnishes an ideal combination of feeds, which may be used combined or independently from three separate intakes if so desired, in event of trouble or the unwatering of either.

The placing of the 36-in. and 20-in. valves at the by-pass below the Venturi meter gives the advantage of operating either or both mains without disturbing the chlorination treatment.

From this point the supply is conveyed to the city by two mains. The 20-in. shown on the plan is reduced to 16-in. at the foot of the escarpment and enters the distribution system at the extreme westerly end. The 36-in. is laid to the shaft of the tunnel as shown, the tunnel being 6 x 8 ft. in section for a distance of 4,200 ft. to a concrete bulkhead where it connects to a 24-in. cast-iron main laid to and across the centre of the distribution, a distance of 21,000 ft., thus affording ample time for complete chlorination before the supply reaches the consumer.

The 36-in. Venturi meter is the product of the Builders' Iron Foundry of Providence, R. I. It is designed especially for the rather unusual local conditions, the recording apparatus being the float-operated type "M" register, indicator-recorder, the indicator and recorder being in Imperial gallons, while the register is shown in cubic feet.

The recorder is placed directly over the float pipes, thereby obtaining the best possible results in operation, not only of the meter recording apparatus, but also of the chlorine regulating mechanism operated from the recorder, all possible frictional losses being eliminated.

The liquid chlorine apparatus was made and installed by The Electro Bleaching Gas Company, of New York, and is known as their Model "C," automatic type of equipment. The installation was made on a parallel centre line with the meter recorder, at a distance of 3 ft. from centres, and the operation may be described as follows:

From an aluminum sheave fitted to the shaft at the back of the meter indicator dial, a tension cord is carried at a right angle to one of a pair of sheaves bracketed on the pedestal of the chlorine controlling apparatus. This tension, or driving cord, is properly counterweighted so that it will take up and convey to the chlorine equipment the slightest movement of the meter indicator shaft.

The two sheaves on the apparatus known as "A" and "B" in the operations are mounted on the same shaft, and sheave "A," which is driven by the tension cord from the meter, is so proportioned in dimension that a variation in the diameter of the "B" sheave will permit of an adjustment to secure any desired rate of chlorine feed per 1,000,000 gals. of water passing through the Venturi meter tube. In other words, in order that the quantity of chlorine to be applied may be adjusted to meet the varying quality of the water, it is necessary that the amount of movement originating at the meter indicator and transmitted by the tension cord shall be increased or diminished to secure the desired action on the chlorine controlling valve. This is the purpose of the "B" sheave, and it is therefore of such design that it can readily be removed and replaced by sheaves of larger or smaller diameter.

From this "B" sheave another properly balanced cord passes over a small, loose guide pulley, mounted on the electric mechanism box. This cord is connected to one part of an electric contact carriage or switch device. This entire mechanism is unique and of desidedly interesting design, and correspondingly difficult to describe. The function of this switch is to make, break, and reverse the current passing to a small motor, which operates indirectly through a series of gears, the valve controlling the delivery of the chlorine gas.

The operation of this switch may be briefly stated as follows: The floating portion is moved vertically a proportional fraction of the total movement originating at the meter indicator. At the inception of this movement contact is made with the second portion of the carriage, so that the circuit is closed on the motor. As the motor operates the screw shaft revolves, moving the section portion of the contact carriage vertically up or down, as the case may be, until its contact with the floating portion is broken, and the power circuit opened. This, therefore, stops the motor as soon as the movement of the meter indicator ceases.

The chlorine control valve is actuated by the motor through this same vertical screw shaft by universal joint connected shaft driving bevel back gearing connected by a spur to a pinion on the spindle of the diaphragm regulating valve, this latter being the immediate control of the gas passing to the absorption tower.

As all operations and adjustments of the mechanism start from zero, the large pinion on the valve spindle has been calibrated to indicate on its face from zero the percentage of valve opening, thus enabling the operator to check the momentary flow of chlorine as given on a table furnished by the manufacturer of the equipment. An additional check is provided by the "rate of flow" gauge mounted on the left which indicates the flow of chlorine in ounces per hour. At the upper right of the frame is the chlorine cylinder pressure gauge, on the indicator of which is fitted a circuit closing arm, from the contact points of which are carried wires to a large alarm gong, in the caretaker's residence nearby, operated by two dry cells, which gives a very positive alarm when the cylinder pressure reaches the low point for which it is set.

From the cylinders the chlorine passes through the controlling apparatus to the absorption tower, discharging near its base, the tower being filled with broken pumice stone and receiving a continuous flow of water from a ¾-in. pipe fitted at its top to provide complete absorption of the chlorine, the chlorinated solution being thence carried by gravity to the 36-in. main below, discharging at the axis of the pipe. The absorption tower and all pipes and fittings in contact with the chlorine or solution being made of vulcanized rubber.

Electric current enters the building at the right of the apparatus to a switchboard, 120 volts, 66 cycle, and for the operation of the apparatus is transformed to 10 volts single phase by means of a Viking pony transformer wired through the contact carriage to the motor, the operation of the electrical apparatus being entirely automatic, on the movement of the temporary rate of flow recorder. In event of line or other electrical troubles the apparatus may be operated temporarily by a battery of six dry cells, for which provision is made. In addition to these it is the intention of the writer to install a small direct-current generator, driven by a Pelton or similar water wheel in the basement of the adjoining valve house, giving an independent triple source of power, reducing to a minimum the danger of shut-downs from power sources.

The plant was placed in operation on August 10, 1914, and with the exception of some slight adjustments to tension cords, etc., has required no attention, and has been highly satisfactory both as to mechanical operation and results produced in the sterilization of the supply, the reports of the chemist indicating complete destruction of B. Coli in the treated water, while the samples untreated indicated pollution in nearly every instance.

Owing to the rather variable character of the supply it has been found necessary to keep close observation as to bacterial conditions, and to adjust the ratio of dose to meet these, but so far the maximum dose applied has been 3 lbs. of chlorine per 1,000,000 Imp. gals., which was used for a short period during October, following severe storms on the lakes. For some time and at present we are applying 1.65 lbs. per 1,000,000 gals. and are obtaining the desired results.

The installation of the chlorine and meter apparatus was under the supervision of Mr. J. A. Kienle, C. E., representing The Electro Bleaching Gas Company, and all the apparatus was properly adjusted and tested by him and the writer for efficiency and accuracy when placed in operation, and again after three months' operation before final acceptance. Frequent zero tests were made by the writer to ensure proper working.

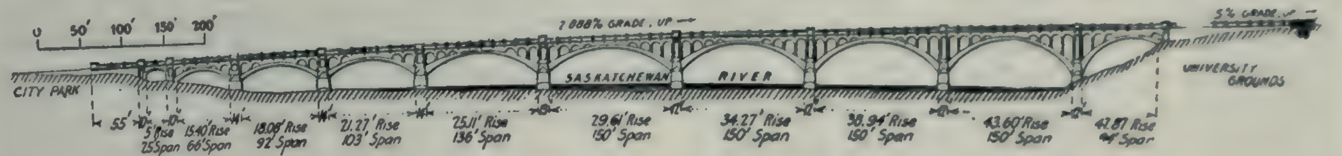
Wiring Reinforcing Bars at Splices

In the early days of the reinforced concrete industry, the wrapping of spliced ends of reinforcing bars with many turns of wire was commonly accepted as good practice, it being supposed that such wiring aided materially in developing the proper strength of splice. Numerous laboratory tests have in the meantime proven beyond a doubt the utter fallacy of this belief. It is therefore rather surprising that some textbooks, designing engineers, and railroads still force this mistaken idea to the front by specifying securely wired splicing wherever reinforcing bars are spliced.

In some cases the lap of bars was cut down materially on account of the fact that the wiring was assumed to transmit some of the stress. This practice is "courting disaster," since no wired splice can be made strong enough to prevent considerable slip (that is enough to rupture the concrete) when stress is applied, before the wired splice comes into action. Laboratory tests made by various recognized authorities prove this.

If the wrapping of spliced ends of bars with 15 or 20 turns of wire will not justify the cutting down of the necessary lap length to develop the bar in bond, why spend money for labor and material for a useless purpose? It may be well to wire the bars together with a few small pieces of wire to hold them in place; but to envelop them in a wire coil is not economical, to say the least.

No more efficient splice has yet been developed for reinforcing bars, than the simple method of lapping them a certain number of diameters (depending on the type of bar), to develop the splice by bond between concrete and steel; and it would be well for many engineers to bear this in mind when designing concrete structure.—Railway Engineering.



General elevation—Note the segemental arch at the right.

The New Reinforced Concrete Highway Bridge at Saskatoon

THE new reinforced concrete highway bridge over the Saskatchewan River at Saskatoon was described in its main constructional features in our issue of February 10 last, but the following details contained in a more comprehensive article published in a recent issue of The Engineering News are of sufficient added interest to justify our returning to a consideration of this work, which is noteworthy for the use of the pneumatic system of placing and delivering the concrete.

The Board of Highway Commissioners designed bridges of two types: one having a steel superstructure on concrete piers, and the other consisting of a series of reinforced concrete arches. The estimated cost of the two types varied by only about $6,000, and the question became one of type rather than cost. A steel bridge with floor at so heavy a grade presented difficulties, and a concrete bridge was chosen because of better appearance and as best suiting the requirements.

The total length of the bridge and the retaining walls in its approaches is 1,490 ft. It consists of one span each of 25 ft., 66 ft., 92 ft., 103 ft., and 136 ft.; four spans of 150-ft., and one irregular end arch span of 94 ft., having its abutment end some 40 ft. above its springing on the pier. The 150-ft. arches are notable as being longer in span than any of the same kind in Canada. The bridge is on a grade of 2.88 per cent. rising to the east. The total width of floor is 65 ft., including two 8-ft. sidewalks on cantilever brackets. Provision is made for a double-track street-car line between two 14-ft. roadways. The spans consist of two arch rings 16 ft. wide, 15 ft. apart. The floor system is supported by spandrel walls and columns, and is made up of beams and girders.

By agreement the Board of Highway Commissioners was to carry out the work, the city paying 33 per cent. of the cost, and the city engineer being given opportunity to inspect the work and materials. Bids were opened July 15, 1913, and the contract was let to R. J. Lecky & Company, of Regina, as the lowest bidder. The price for the estimated quantities was $240,000. The cement and reinforcing steel are supplied by the Board, and bring the total cost to about $400,000.

The work was commenced August 27, 1913, and continued through the fall and winter. In April, 1914, all the piers (except two river piers) were completed. The abutments and retaining walls (west side) were also done. Concrete for all except two piers was carried only to 8 ft. below the springing line. Considerable trouble was experienced with the third pier from the east end, and it was left with excavation only partly completed. For the river piers the coffer-dams consisted of a double row of Wakefield sheet piling separated by a puddled-clay wall. A single row proved inadequate, and was the cause of the trouble in the third pier. This pier was attempted again in August, using a double row of sheet piling, and was successfully carried to completion.

The first two arches were poured in June, and the third in August. The last arch was poured November 13. The completion of the arch rings ends the season's work. The floor system will not be built this winter. Fig. 1 shows the condition of the work in November, 1914. Fig. 2 is a general elevation, and Fig. 3 shows the structural design.

Loading

The loading for the floor is as follows: (1) On each track a concentrated load of 100-ton double-truck cars having a wheel spacing of 5, 15 and 5 ft., with 12½ tons per wheel; (2) on the remainder of the roadways a concentrated load of a 25-ton traction engine with wheels 8 ft. c. to c. and 10 ft. between axles, 66 per cent. of weight on rear wheels (30 ins. wide); (3) on the sidewalks a uniform load of 150 lbs. per sq. ft.

The loading for the arch rings includes a uniform load of 200 lbs. per sq. ft. for the central 17 ft. of the bridge, 150 lbs. for the remainder of the roadway and 150 lbs. for the sidewalks.

The maximum allowable stresses are as follows: Concrete, 600 lbs. per sq. in. for compression and 50 lbs. for shear; steel, 13,000 lbs. for tension and the compression to be not more than 15 times that of the concrete. In the calculation of temperature stresses the assumed range was from —50 deg. to + 90 deg. F.

Foundations

The subsoil is a very hard blue clay, almost a shale. As the excavations reached the required depth, test holes were bored some 18 ft. further and these indicated blue clay of the same general type. For loading tests a frame was used having a bearing surface a foot square, supporting a platform upon which known weights were applied. Readings for elevation were taken, extending over 48 hours. The experiments showed that the foundations would safely carry more than the maximum loading.

It was originally intended to place pre-molded concrete piles under the abutments and shore piers, but it was found that the subsoil was so hard that these piles could not be driven, nor were they necessary. Wood piles were used under retaining walls in approaches, and in part of the east abutment.

Arch Design

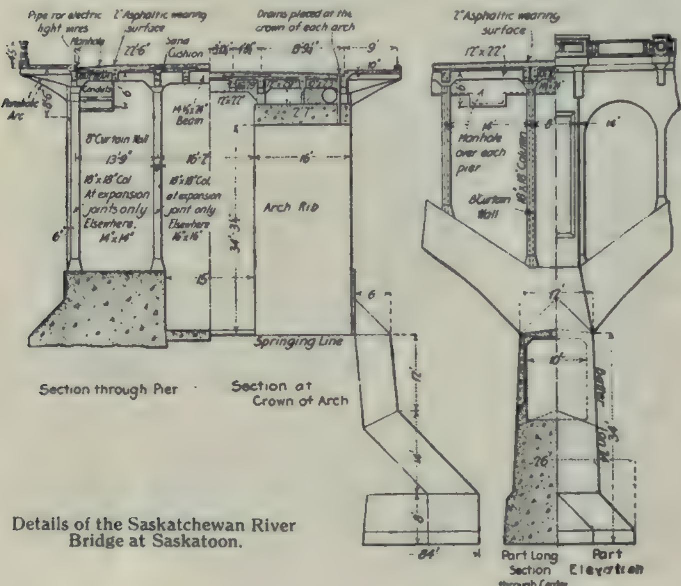
The arch rings were figured by the analytical method given by Turneaure & Maurer. The exceedingly high temperature variation assumed (—50 deg. to + 90 deg. F.) added greatly to the difficulties of design, and in some cases the temperature stresses were greater than all other stresses combined. Considerable time and distraction were saved the computer by ruling the tables required in the calculations on tracing linen and using whiteprints made from them.

The grades to the floor system made all the arches different in rise, and separate designs had to be made for each of the ten arches. The large number of arches to be figured gave excellent practice to the computers, and the complete calculations for a trial design were done in as short a time as five hours.

Concreting

For the first arches the concrete was mixed in a batch mixer and handled by an elevator tower. Since August the concrete has been placed by a pneumatic concrete mixer, situated on the high east bank. This method (on the McMichael system) was adopted as being most economical. The apparatus is owned by the Pneumatic Concrete Placing Company, of Montreal, and was rented on a royalty payment per cubic yard of concrete deposited.

The mixer was of ½-yd. capacity. The number of batches per hour varied with the distance to point of delivery, being about 50 and 35 for distances of 375 and 1,000 ft., respectively. A typical day's work was 500 cu. yds. in 17 hours. The air pressure was 110 lbs. at the receiver. The delivery pipe was 8 ins. diameter, with a maximum length of 1,000 ft. This pipe was laid along a trestle built above the centering at about the level of the floor. It ended in a discharge box from which troughs were laid to the point of deposit.



Details of the Saskatchewan River Bridge at Saskatoon.

In regard to the winter work, this was confined largely to placing coffer-dams and excavation. No concrete was poured in the cold months of January and February. One pier was poured in December, with temperatures ranging from 50 to 40 deg. F. Two piers were poured in March, with temperatures from 15 to 48 deg. F. For all this winter concreting the water was heated with a jet from a boiler. Another steam jet was used to heat the gravel when the temperature made this necessary.

The mixer was placed close to the work, and the mix was deposited either by an elevator and chutes or by wheelbarrows. Freshly laid concrete was covered with canvas for a few days. All concrete laid last winter has been entirely satisfactory.

A pit-run gravel was used for the piers, and a coarser washed gravel was added to this for the arches. The specifications provided for concrete of the following proportions, measured by volume, loose: (1) Arch rings, columns, girders and concrete deposited under water, 1:2:4 (stone) or 1:5 of sand and gravel combined; (2) abutments, piers, walls, aprons, etc., 1:3:5 or 1:7; (3) for the outer 4 ins of ice breakers on piers, 1:2:2 (stone). The concrete was spaded in the forms to flush the cement to the faces. After the removal of the forms, all surface cavities were pointed by filling with "dry mortar from which the surface film of cement must be removed before it sets."

Exposed surfaces of piers and arch rings were rubbed with carborundum brick to remove irregularities. The remaining exposed surfaces had the film of cement removed with stiff wire brushes and clean water. No cement wash was permitted. Plastering was permitted only on surfaces to be covered or backed with earth filling.

Waste Prevention by Individual Meters vs. District Meters

R. O. Wynne-Roberts, Regina

THERE are many cases in which it would be difficult to make an equitable charge for water consumed unless the quantity were measured: these are industries, institutions, premises requiring water in very small quantities for sanitary purposes, and large consumers. But the large majority of consumers do not actually need much water, although it is well known that an inordinate quantity is used or misused. This has arisen in some instances from the fact that it was considered more economical to supply water than to check its consumption. In other cases it is due to indifferent management and neglect on the part of some of the water authorities until the waste has created serious disabilities.

There is now a general movement for the conservation of water, and the means usually taken is to install individual meters on all water connections. The object of this short paper will be to discuss the question whether the general installation of individual meters or the provision of district meters is to be advocated.

Waste of water must be eliminated as far as is practicable and economical, for the keynote of successful management of all businesses is to stop leakages of all kinds.

A waterworks system loaded with a high rate of supply is not unlike a ship which has a constantly leaking water ballast—for neither the waterworks nor the ship can be operated to its full legitimate capacity, or made to be revenue producing to the extent it should be. The proprietors of the waterworks who propose to install a general meter system so as to reduce some of the leaks may be compared to the shipowners who have some of the leaks in the ship's hull repaired and pumps provided to reduce the water ballast. Carrying the analogy still further, the waterworks proprietors who install bulk and district meters, a few individual meters, and by means of efficient inspection reduce all leaks to a minimum, are similar in purpose to the shipowners who have the ship's hull thoroughly overhauled and ample pumps provided to keep the water ballast empty. In both these cases the property is maintained in an efficient condition and made to produce the maximum revenue at the minimum cost.

Most of the cities are comparatively small, and if it be assumed that the average size is about 20,000 population it will doubtless represent a large number of towns. The unrestricted total consumption is, say, 150 gallons per head daily. In such a city there would be about 3,500 water connections, and if all are metered there would be that number to fix and maintain. The water authority, to secure full control over the meters, would buy the meters and rent them out.

Adopting the careful analysis of costs made by the Wisconsin Railroad Commission and mentioned in their report of 1911, the average annual cost is as follows:—

Labour, moving and resetting meters		$0.18
Labour, meter and fittings department ...		0:34
Supplies, meter and fittings department ...		0.12
Maintenance of meter		0.35
Reading meters and delivering bills		1.35
		$2.34
To these must be added		
Depreciation—say	$0.50	
Interest	0.36	0.86
Per meter per year		$3.20

The cost of metering will fall on the consumers, and in this case it would amount to $11,900 per annum.

The cost of filtered water at the works will be about $3.50 per million gallons.

Individual meters measure the water entering the premises and consequently constitute good waste detectors. The saving in the quantity of water used before and after installing meters varies greatly, but in all cities metering has effected a tangible reduction in the quantity of water pumped. Published figures are often misleading because the diminution in the quantity consumed by the people is often small compared to the losses on the mains. When the total quantity of water registered by individual meters is ascertained, the unaccounted-for losses amount to from 20 to 66 per cent. of the total quantity pumped. It will be fair to expect thirty-three per cent. reduction in the pumpage by universal metering. Supposing the head on the pumps is 100 feet and the price of coal is $4.00 per ton, then the saving in fuel due to diminished pumpage wil be about $1,200 per annum. The cost of labour will remain practically the same.

District meters could be installed in this city for about $3,000; a small number of individual meters would be required as explained in the commencement, and inspectors would be employed to make a systematic and frequent survey of the whole waterworks. The annual expenditure in this case would be as follows:

Interest on $3,000	$150	
Depreciation	150	
		$300
2 Inspectors	$2,500	
Clerks, etc.	1,500	
		4,000
250 meters at $3.40		850
Miscellaneous		250
Total		$5,400

By careful and diligent inspection the pumpage should be gradually reduced to one-half, and the saving in fuel on the same basis as before would be $1,800.

The above estimate is a liberal one. The writer had control of waterworks and by the adoption of this method was able to supply the public on less than 30 gallons per head daily for all purposes; the railroad companies were large consumers. The London Water Board use from 1,300 to 1,400 Deacon meters to detect waste, and by discovering and localizing leaks the average supply is under 45 gallons per head daily. By means of pitometer survey at Ottawa, Ont., leakages amounting to 5,300,000 gallons per day were remedied in a short time. Washington has in seven years detected leakages aggregating 40 million gallons daily. Three permanent self-recording district meters have been installed in Regina, but systematic inspections have not yet been started. The records obtained from the district meters enable the officials to detect leaks and to localize them and by this means to keep the consumption at a reasonable figure. Such meters and records are a check on the pumps and on the daily occurrences in the district controlled.

The reduction of waste is equivalent to increasing the capacity of the waterworks to meet growing demands, and at a reduced cost or with an increased revenue.

Even in cities where the rate is fixed by the Public Utility Commissions and where individual meters are compulsory, district meters are essential to provide an efficient and economical system. With both individual meters and self-recording district meters the quantity of water necessary to satisfy all requirements should not exceed 50 gallons per head per day, except in special cases where the industrial consumption is abnormally high.

The financial situation as estimated in the foregoing illustrations will be as follows:—

Individual Meters

Cost of operation	$11,900	Saving in fuel	$1,200
		Value of water saved	1,277
			$2,477

District Meters

Cost of operation	$5,400	Saving in fuel	$1,800
		Value of water saved	1,914
			$3,714

The differences between the estimated cost of operating the two methods and the savings effected by them are $9,423 and $1,786 respectively. The extra cost per water-paying consumer per annum is $2.70 and 52 cents.

Wood Block Replaces Plank as Steel Bridge Flooring

TO those charged with the responsibility of maintaining old steel highway bridges has come, no doubt, a full realization of the desirability of a better type of bridge floor other than that of common plank. Plank floors are at best a makeshift, expensive and difficult to maintain in a safe condition for public travel, although they may be economical on old bridges with a very light traffic. Moreover, if the plank are not graded with great care when laid a few will decay and develop defects long before the floor becomes generally bad. This repairing is done by a local supervisor who usually places a patch over each defect, subjecting the traffic and also the bridge to a series of shocks and jolts.

Plank floors naturally divide themselves into two classes—those that wear out by traffic, and those that fail by decay. Of the latter type a 3-in. number one, white oak floor may last from six to ten years, and of the first type the life is regulated by the kind and amount of traffic.

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* By Edward Stingel in the Engineering Record.

The object of this article is to review what is being done by Tuscarawas County, Ohio, in replacing plank floors on old steel bridges where the traffic is sufficiently heavy to cause plank failure after two to five years' wear.

PLANK FLOORS A FAILURE

It is increasingly more difficult, in this locality, to secure number one, white oak plank. Therefore red oak plank are occasionally used, and in some cases hickory and beach, both of which have proven failures because of their tendency to decay. Double floors have been discarded because of the tendency to retain moisture between the layers. Occasionally a double floor is used in a case where the old plank are badly worn but sound; then a 2-in. plank floor laid longitudinally may be economical.

Five years ago this county laid its first wood block floor on an old steel bridge, and since then more than 8,000 sq. yds. of this type of floor have been laid, and those in authority believe that the floor problem, in so far as it affects old steel bridges, has been solved. Most old steel highway bridges are of the pin connected type with a loose, wabbly, suspended floor system. The vibration in many cases becomes a sway when crossed with a heavy load because of the loose construction of the floor system.

A wood block floor on this type of bridge has the very desirable effect of stiffening the structure to a very decided extent. In fact, the floor system behaves more like that of a solid rivetted structure. This gives a sense of security which is desirable, and the bridge is not subjected to the severe jolting and racking as is the case under the old conditions.

SPECIFICATIONS

The methods of block manufacture, creosoting, laying, etc., are covered by detailed specifications of which a few excerpts are here given:

Plank.—The plank shall be 3 in. thick after being surfaced, 10 in. wide and shall be in length equal to the full width of the floor. The wood shall be regular commercial yellow pine, which shall be free from knots or other defects. A minimum of six annual rings to the radial inch shall be required of all lumber and block.

Block.—All block shall be 3 in. deep, 3 in. wide and 6 in. long and shall be cut from lumber as above specified. They shall be rectangular and uniform in size, and shall be dressed on one side. No block shall vary in width and depth more than 1/16 in. from the specified size.

Creosoting.—All plank, nailing strips, curbs, blocks and all other wood used shall be creosoted with 18 lb. of creosote oil per cubic yard of wood.

Creosote Oil.—The creosote oil shall be a dead oil of coal tar or coal tar product. It shall not contain more than 3 per cent. of water and if it does contain this amount of water a corresponding correction must be made so that an equivalent additional amount of creosote is forced into the wood. It shall contain only traces of acetic acid and acetates. Its specific gravity at 100 deg. Fahr. shall be at least 1.03 and not more than 1.07 so as to assure its thoroughly penetrating the wood block. The residue insoluble by filtration with benzol and chloroform must not exceed 3 per cent. of the weight of the creosote oil. Fractional distillation of 100 grams of the creosote oil shall produce percentages of dry oil by weight within the following limits:

Up to 150 deg. C.	not to exceed 2 %
Between 150 and 170 deg. C.	not to exceed 1.5 %
Between 170 and 235 deg. C.	not to exceed .35%
Between 235 and 300 deg. C.	not to exceed .35%

The residue remaining shall be soft and adhesive. The creosote oil shall contain about 25 per cent. of crystalizable naphthalene and at least 15 per cent. anthacene oils. At least 95 per cent. of the creosote oil shall be soluble in carbon-bisulphide and equally in absolute alcohol.

INSPECTION

Creosoted wood, even with an 18-lb. treatment, will show uncreosoted near the surface when cut into in some cases. Considerable trouble has been had in the lack of uniformity in creosoting, and especially is this true of plank. To overcome this the specifications now provide that any plank or timber showing uncreosoted wood ½ in. from the surface at any point will be rejected. All plank and other timbers are tested by boring each plank at least in two places.

If the creosoting has been superficial only the piece is rejected. Whenever any creosoted wood is cut for any reason the exposed surface is given one coat of red lead and oil for protection, as lumber is made antiseptic by the creosoting process and should be so maintained. The inspection should also include an inspection at the creosoting plant for the sake of harmony between the engineer, manufacturer and contractor, even if there were no other good reason therefor.

DETAILS OF CONSTRUCTION

Steel stringers are used in all cases; if the old stringers are wooden new steel ones are provided. Old steel stringers are carefully inspected, and especially where they rest on abutments and piers where deterioration will be more advanced than elsewhere. The crown of the roadway is made by placing steel or cast plates of varying thickness under the stringers. The stringers are bolted through these plates to the floor beam flanges with ⅝-in. bolts. The slope of the crown is 1/6 in. per foot. Two nailing strips are used on an 18-ft. roadway and the ends of the plank and the curb are held in place with ⅝-in. hook bolts, spaced 5 ft. on centres, hooked under the bottom flange of the side stringers. The open curb to provide for drainage is preferred over the solid curb and scupper plan. The 4 x 6-in. creosoted curb is elevated above the block surface by creosoted wood blocks, 2 x 6 x 6 in., spaced 5 ft. on centres, which allows the water and refuse on the roadway to escape quickly. The solid curb and scupper plan has been found unsatisfactory because of the tendency of the scuppers to become clogged and closed, causing the water to follow the curb, spill over the approaches and wash ruts along their slopes.

Blocks of uniform size are specified, as they make a neater floor and less care need be exercised in laying them. Much variation is noted in the density of the wood and unless the specifications are rigid in this respect some trouble may be experienced

MAINTENANCE AND COST

There has been no maintenance cost charged against any floor since being laid. The cost to the county, under contract, has been from $4 to $4.75 per superficial square yard, for the work completed, including metal risers, cleaning and painting of the stringers.

Personal Mention

Mr. Arthur J. Darling, president of Darling Brothers, Limited, Montreal, died on March 5, aged 52. Mr. Darling had been in ill-health for some time, but his death was quite unexpected. The firm of which he was head does an extensive business as engineers and manufacturers of steam power pumps, freight elevators, and heating apparatus.

Mr. J. W. Astley, for the last seven years Engineer of Construction with the city of Winnipeg, is resigning owing to a reorganization and curtailment of the city's constructional forces. It is interesting to recall Mr. Astley's appointment in 1908, when the city arranged for him to have the use of all the civic plant and tender against contractors. During his term of office at Winnipeg he has been eminently successful in this respect, with the result that contract work has proceeded on a clean and reliable basis of competition. He is a strong advocate of day labor for certain classes of city work, especially local improvements. A number of articles on this subject from his pen have been published in The Contract Record.

Mr. Charles Wellford Leavitt, the author of an interesting paper on Stands, Stadia and Bowls, published in this issue, is a New York expert in landscape work and city planning who has made a name for himself, not only in the United States, but in Canada. We recall the fact that he has designed and superintended the laying out of numerous grounds in this country, and that he designed a city plan and prepared a report for the towns of Berlin and Waterloo, in Ontario. Born in New Jersey in 1871, he was educated at the Gunnery School at Washington, Conn., and at the Cheltenham (Pa.) Military Academy. He had extended experience in various branches of municipal work before he adopted his present specialty. Mr. Leavitt has designed and supervised the construction of many noteworthy race-tracks, Toronto, Winnipeg and Montreal having come in for a share of his activities in this field.

Mr. W. P. Anderson, the author of a paper dealing with mechanical plant for handling concrete—published in this issue, is a native of Cincinnati. He graduated from the Massachusetts Institute of Technology in 1896, and first became interested in concrete construction in 1901. In the following year he organized the Ferro Concrete Construction Company, which has been actively engaged since that time in designing and building reinforced concrete buildings. In 1902 Mr. Anderson's company prepared the design for the Ingalls Building, a seventeen-storey reinforced concrete structure which was the first building of that height to be erected entirely of reinforced concrete without any structural steel—and still to-day probably one of the highest buildings of its kind. Mr. Anderson is a member of the American Society of Civil Engineers and of the American Concrete Institute.

Lieut.-Col. Lacey R. Johnson, General Superintendent of the C. P. R. Angus shops, Montreal, has been appointed General Welfare Agent of the system—a new position, having for its object the development of voluntary agencies, such as the Safety First movement, St. John Ambulance Association, etc. Lieut.-Col. Johnson was born at Abingdon, Berkshire, Eng., and served as an apprentice at the Great Western Railway Works at Swindon. After working at the Royal Arsenal, Woolwich, he went to India, and in 1882 came to Canada. In 1882 he was appointed General Manager of the Canadian Pacific Railway shops at Carleton Junction, Ont., a position which he occupied for three years. He was then appointed Assistant Master Mechanic of the Pacific Division and Supervising Engineer of the Pacific fleet steamships. He then became Assistant Superintendent of Motive Power at Montreal, a position he occupied for eleven years. On July 1, 1912, he was appointed General Superintendent of the Angus Shops at Montreal.

High Honor for Toronto Architect

As announced in our issue of February 24th, Mr. Frank Darling, of the well-known architectural firm of Messrs. Darling & Pearson, has been nominated by the Council of the Royal Institute of British Architects for the Royal Gold Medal originated in 1848 by Her late Majesty Queen Victoria with a view to promoting the interests of architectural attainment. This medal is granted annually to some distinguished architect or man of letters who has designed a building of high merit or produced a work tending to promote the knowledge of architecture or the various branches of science connected with it. The honor that has come to Mr. Darling is all the more noteworthy on account of its being the first time that it has been conferred upon a member of his profession in any of the Overseas Dominions.

Mr. Frank Darling.

Among the distinguished recipients of this honor we recall Lord Leighton, Sir Aston Webb, Sir Lawrence Alma Tadema, Chas. F. McKim, of New York, Charles Garmin, architect of the Paris Opera House, and Sir Charles Barry.

Mr. Frank Darling was born at Scarborough, near Toronto, in 1850. From Upper Canada College he proceeded to Trinity College School. After studying the elements of his profession in Canada, he went to England, in 1870, and continued under George Edmund Street and Sir Arthur Blomfield. He entered upon his professional career in this country in 1875, and formed his present partnership some twenty years later.

Anything like an enumeration of the really important buildings which Mr. Darling has designed would not come within the province of this column, but we cannot refrain from mentioning the new General Hospital at Toronto—the most comprehensive and successful scheme of its kind in America—the C. P. R. office building, and the new head office building of the Dominion Bank, Toronto, the Canadian Bank of Commerce building, and the new office for the Sun Life Company in Montreal.

The field of Mr. Darling's activities has been a wide one. The materialization of his designs is to be found in Newfoundland, in the Maritime Provinces, in the principal cities of Quebec and Ontario, in the prairie towns, and in Vancouver.

To Command Construction Corps

Mr. C. W. P. Ramsay, Montreal, Engineer of Construction for the Canadian Pacific Railway, has been named as commanding officer of the Canadian Overseas Railway Construction Corps which Sir Thomas Shaughnessy is raising at the suggestion of the Federal Government. The force will be recruited from men having practical experience in steam shovel work, track laying, ballasting, concreting, bridge work, concrete work—in fact in all the various branches of constructional activity. Details of the organization have been forwarded to the C. P. R's. general superintendents throughout the country. The force when enlisted will be mustered at St. John and sent abroad as soon as possible. Mr. Ramsay has been given the rank of Lieut.-Colonel.

Mr. C. W. P. Ramsay.

Mr. J. R. Grant, for several years Secretary-Treasurer of the Vancouver branch of the Canadian Society of Civil Engineers, was entertained at the Vancouver Club recently on the eve of his departure for England, where he is offering his services with the Royal Engineers. Mr. F. C. Gamble, Chief Engineer of the Department of Railways, and President of the Canadian Society of Civil Engineers, was in the chair, while Mr. G. R. G. Conway, Chief Engineer of the B. C. Electric Railway Company, and Chairman of the local branch of the Society, was Vice-Chairman. During the evening Mr. Grant was presented with a military wrist-watch as a souvenir of the dinner. In addition to those already mentioned, the following were among those present: Messrs. T. H. White, R. F. Hayward, W. Anderson, J. W. Blackman, D. Cameron, C. E. Cartwright, F. L. Fellowes, A. G. Dalzell, H. K. Dutcher, H. B. Ferguson, N. J. Ker, F. S. McDiarmid, J. McPherson, A. K. Robertson, B. R. Warden, R. H. Winslow, J. H. Kennedy, H. E. C. Carry and E. A. Cleveland.

Mr. J. A. Johnston, of Springfield, Mass., Division Engineer for the Massachusetts Highway Commission, directs our attention to a mis-statement in our issue of January 27 last, in which was published an interesting article of his entitled "Foundations—The Main Factor in All Road Work." The mis-statement occurred in our "Personal" column, in which it was said that Mr. Johnston was appointed one of five Division Engineers eight years ago. The appointment was actually made on January 1, 1897, which is rather more than eighteen years ago.

To the Honor Roll of engineers on active service must be added the names of the following students or graduates of the Engineering Course in the University of Manitoba: F. C. Cameron (1912), 2nd Contingent, Engineers 2nd Field Troop; C. N. Mitchel (1912), 2nd Contingent, Engineers 2nd Field Troop; G. L. Shanks (1912), 2nd Contingent, Engineers 2nd Field Troop; A. J. Taunton (1912), 3rd Contingent, 100th Regiment; H. R. Urie (1913), 1st Contingent, Engineers 3rd Field Troop; W. S. Collins (1914), 1st Contingent, Engineers 3rd Field Troop; W. H. Jones (1914), 2nd Contingent Engineers 2nd Field Troop; W. H. Richardson (1914), 2nd Contingent, Engineers 2nd Field Troop; V. Tait (1914), 1st Contingent, Engineers 2nd Field Troop; E. D. Hicks (1916), 2nd Contingent, Princess Patricia Volunteers; H. Levinson (1917), 2nd Contingent, Engineers 2nd Field Troop; J. C. Mitchel (1917), 2nd Contingent, 106th Regiment; J. W. Murphy (1917), 2nd Contingent, 106th Regiment; R. L. Stevenson (1917), 1st Contingent, Engineers 2nd Field Troop; F. E. Wootton (1917), 2nd Contingent, 13th Field Battery; J. F. Leathers (1918), 2nd Contingent, 13th Field Battery.

New Bridge Over the Petitcodiac in New Brunswick

TENDERS for the erection of the Moncton Bridge, over the Petitcodiac River, N.B., will be received until the 31st inst. The bridge will be one of the most important works in the Lower Provinces this year, and its erection involves difficult problems owing to the enormous rise and fall in the tide of the river, the extremes being 30 ft. The tenders are in two sections, for the substructure and the superstructure, and it is probable that some well-known firms, including at least one prominent English company, will be among the bidders. The bridge, which will replace the present wooden structure, will be 1,787 feet long, including earth and stone embankments, and the superstructure will be erected on two masonry abutments and four masonry piers. With regard to the latter, tenders are invited for the work to be foundationed either by the pneumatic process or open dredging process.

The superstructure will consist of one fixed through rivetted span of 355 ft. from centre to centre of end bearings and four fixed through rivetted spans of 261 feet, and the bidders have to submit designs on which their tenders are based. The approximate weight will be 2,420,000 lbs. There is to be a 6 ft. clear width sidewalk along the downstream side of the bridge, while the wagon roadway is to be paved with creosoted wood blocks 4 in. deep, resting on reinforced concrete slab work. All steel is to be open hearth medium steel. Side railings of lattice will be provided on both sides of the bridge.

The provincial engineer for New Brunswick is Mr. A. R. Wetmore, of St. John.

Mainly Constructional

East and West—From Coast to Coast

At the next meeting of Legislature the township of Finch, Ont., will make application for incorporation as a town.

The Mond Nickel Company, Limited, of Great Britain, has been authorized to carry on a general mining, smelting and refining trade in Ontario.

The St. Matthew's Evangelical Lutheran Church has been completed at Berlin, Ont., at a cost of $60,000. The new building was dedicated recently.

The corporation of Ottawa will apply for power to raise money for extension and equipment to the Municipal Electric System, and also for extensions of the waterworks system.

The corporation of Toronto will apply for an act to compel the Toronto Railway Company to construct thirteen miles of new track, and to build and place in operation 180 new cars.

The Master Painters' Association held their annual dinner at Hamilton on the evening of February 9. The function was presided over by Mr. A. M. McKenzie, President of the International Association.

The municipal corporation of Hanover, Ont., will apply to the Legislature for an act to validate a by-law providing for the borrowing of $3,300, for extending and repairing streets and roadways.

The Toronto & York Radial Railway Company will make application to the Legislature for authority to operate double tracks on Yonge Street from the company's most southerly terminus to the northern limits of the city.

Seven manufacturers of brick tendered for the supply of 5,000,000 bricks to be used by the Montreal Council in the construction of sewers. The National Brick Company, of Laprairie, secured the order at a price of $9 a thousand.

At Victoria, B.C., the special civic committee appointed to look into the revision of the building code held its first meeting recently, when members of various organizations identified with building construction attended and took part in the discussion.

The Corporation of the city of London, Ont., will apply for validation of seven by-laws to provide for the borrowing of various sums for sewer and road work. Application will also be made for authorization to raise $50,000 for a trunk sewer and $18,250 to pay for lands for sewage disposal works.

A causeway and land company, with $2,000,000 capital, is being organized to construct an ornamental and concrete bridge from Huron Point, three miles from Mount Clemens, Mich., across Lake St. Clair to Parsons Island. The bridge will be about two miles long, with a draw in the middle. It will be highly ornamental, and brilliantly lighted at night, and cost approximately $1,500,000, to be maintained under a toll system. The bridge will be wide enough to admit automobiles and other vehicular traffic, a double-tracked street car system, and a walk in both directions for foot passengers.

The great law suit over the boring of the Roger's Pass tunnel on the line of the Canadian Pacific Railway in the Selkirks was the subject of a recent judgment by Justice Clement at Vancouver. J. McIlwee & Sons, of Denver, Colo., sued Foley, Welch & Stewart for $500,000 damages, made up of $250,000 as bonus for fast boring work and a similar amount for prospective profits. Judgment is given for the plaintiffs for $31,000, but they also get costs, which will be another $30,000. The Judge held that the plaintiffs should have gone back to work when they were offered a chance after the first dispute between the contractors and sub-contractors occurred. The hearing of the case in Vancouver took up sixteen days, and prominent engineers from all over the continent were called as witnesses.

An unfortunate accident happened in Esquimault, B.C., harbor recently in the capsizing of a floating dry-dock and cribs. The contractors, Messrs. Grant, Smith & McDonnell, are confident that the actual damage will be restricted to loss of time and minor structural matters. The two cribs which were ready for transferring to the outer harbor are part of the 54 cribs of this character to be constructed, and were being built on a dock 325 feet long by 35 feet high from the deck to the top of the tower.

Road Congress at Winnipeg

At the Manitoba Agricultural College last week a convention of highway engineers and others discussed the various problems identified with road construction. The three essentials upon which all the delegates were agreed were—first, drainage; second, drainage, and, third, drainage. Nearly every speaker referred to this question of drainage, emphasizing the fact that unless the surface water were drained by properly constructed ditches road-building was useless.

An interesting paper on "Low Cost Roads" was presented by P. P. Sharples, of New York, who quoted types and prices, and then spoke on the subject of Manitoba roads. He advised that dirt roads should be built with the ultimate view of using them as a basis for a better type. He deplored the fact that in Manitoba there was no adequate arrangement for road maintenance, and suggested an annual levy—rather than the sale of debentures—as the best means of raising the requisite funds.

Mr. W. F. Tallman, Street Commissioner of Winnipeg, presented a paper which was read by Prof. Smith. This paper dealt principally with the important features to be considered in the construction of country roads—location, road-bed and road-surface being dealt with in turn.

Some interesting information on road construction generally was given by Mr. A. McGillivray, Highway Commissioner for Manitoba.

The delegates passed a resolution in favor of holding a Good Roads Convention annually, and of memorializing the Government to take such steps as will ensure that the deliberations of the delegates will receive wide publicity throughout the various municipalities.

A more detailed report of the meeting will be given in our next issue.

New Companies

With head office at Crown Hill, Ont., The Crown Hill Telephone Company, Limited, has been incorporated with a capital of $6,000. The Provisional Directors are A. E. Partridge, Joseph Caldwell, W. E. Partridge and Anthony Keat, of Vespra; I. H. Luck and E. C. Drury, of Oro; and J. M. Hickling, of Barrie, Ont.

The town of Ladner, B.C., is to be the home of Taylor Electric, Limited, a company newly incorporated with a capital of $10,000. The company will specialize in electrical engineering and contracting.

A branch of the English firm of motor car builders, Rolls-Royce, Limited, has been incorporated with a capital of $10,000. The head office will be in Toronto.

To carry on business in all branches of construction work, the Gordon Construction Company, Limited, has been incorporated with a capital of $200,000, with head office at Niagara Falls, Ont. The Provisional Directors are George

Gordon, J. L. Dawson, G. H. Dawson, W. E. Gordon and H. F. Upper, all of Niagara Falls.

The Canada Universal Nut Lock Company, Limited, Toronto, Ont., has been incorporated with a capital of $100,000. The Provisional Directors of the new company are J. M. Robinson, J. Boothe and T. H. Peine, of Toronto.

The Western Electric Company, Limited, with head office at Vancouver, B.C., has been incorporated with a capital of $10,000. The company will carry on the business of electrical dealers and contractors.

Toronto has a new building supply firm in Boyd-Brandon, Limited, which has been incorporated with a capital of $100,000. The Provisional Directors are Robert Boyd, S. E. Brandon and W. B. Milliken, all of Toronto.

R. D. Clark & Sons, Limited, of Montreal, Que., have been incorporated with a capital stock of $50,000. They will carry on a general construction business.

From the Link-Belt Company we have received copies of their bulletins Nos. 207 and 212. The former describes and illustrates the Link-Belt Electric Hoist, an improved and highly efficient hoist which effects a considerable saving in time and cost. The latter relates to the Wendell Centrifugal Coal Drier, a compact, self-contained machine in which the drying of coal by centrifugal force has been converted into an automatic and continuous operation. The Wendell Drier is a machine which automatically retains the material for a definite predetermined time for drying. The entire performance is continuous, and is accomplished by centrifugal force and gravity. No scraping or plowing devices are used, excessive wear and power being thus eliminated.

The Canadian Equipment Company, Limited, with head office in the Guarantee Trust Building, Montreal, have opened a branch office at St. Catharines, Ont. The new office is in charge of Mr. John G. Beck, whose headquarters are in the Bank of Nova Scotia Building. The company handle a complete line of railroad and construction equipment and machinery, and they are prepared to make immediate shipment of locomotives, passenger cars, freight cars, dump cars, steam shovels, wrecking cranes, locomotive cranes, pile drivers, ballast plows, spreader cars, hoisting engines, etc. As agents for the Bucyrus Company, and the Western Wheeled Scraper Company, they are prepared to supply complete information on all kinds of earth and rock handling machinery.

"Steam Turbine Drives for Rolling Mills," is discussed in a well-illustrated pamphlet distributed by the DeLaval Steam Turbine Company, of Trenton, N.J., who recently installed the geared steam turbine driving an 18 in., three-high roughing mill at the plant of the Carpenter Steel Company, Reading, Pa. This turbine displaced a simple engine and is operated upon the exhaust steam from the cross compound engine which drives the finishing mill. It is estimated that the saving from the use of the turbine is approximately $15,000 a year, while the total cost of the installation was approximately $25,000. Numerous photographs and drawings are given, as well as detailed information. This pamphlet will undoubtedly interest designers and managers of steel mills.

A home-made waterwheel has been instaleld by one of the farmers on the Salt River Reclamation Project in Arizona according to the "Reclamation Record." Two buggy wheels, placed about 8 ins. apart and connected at intervals at the rims by 10-in. paddles, serve to generate the power, which is used for domestic purposes. Fixed on a leverage the wheel may be lowered into the water of the irrigation canal whenever wanted for use. At other itmes it hangs high and dry.

An Interesting Practical Test that Proved the Sounding Board Valueless

SINCE its erection in 1910, the Amasa Stone Memorial Chapel of Adelbert College has proved to be unsatisfactory acoustically. The general shape of the building, which is one of the Western Reserve University Group in Cleveland, Ohio, is a long and narrow rectangular, 140 feet by 30 feet, and experiments showed the difficulty to be due to general reverberation.

It was suggested that a sounding board be installed to eliminate this reverberation, and Prof. Frank P. Whitman, of the University, undertook a series of experiments to determine as accurately as possible just what benefit would be secured by this means.

Great care was taken to make the tests under conditions as nearly as possible like those of the ordinary use of the chapel, and involved the actual hearing of ordinary speech. The final comparative test was made first without and then with the use of the sounding board.

This board was of the horizontal type, generally considered most effective, hexagonal in shape, and six feet in diameter, surrounded by a vertical rim which extended six inches below the plane of the board. It was supported at a height of a little more than two feet above the head of the speaker.

Interior of the Memorial Chapel.

Final results showed that the greatest benefit obtained by the use of the sounding board was to make the hearing two per cent. better in some parts of the building under certain conditions, while it actually made hearing less easy in the gallery.

Prof. Wilson showed that for all practical purposes the sounding board was useless.

The H. W. Johns-Manville Company was then asked to undertake the correction of the chapel by its system based on the scientific researches of Prof. Wallace C. Sabine, of Harvard University. J-M Acoustical Treatment was applied to the ceiling panels and upper walls, and this resulted in the elimination of all the acoustical defects. The accompanying photograph shows the interior of this chapel.

The Canadian Buffalo Forge Company, Limited, Berlin, Ont., advise us that, in place of shrapnel, they are now manufacturing highly explosive lyddite shell, and that they have for immediate disposal a complete Hoskins furnace equipment, one scleroscope, one nosing press of their own manufacture, and several gauges.

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The International Road Congress at Toronto

THIS issue is designed particularly to appeal to the hundreds of delegates to whom Toronto extends a warm welcome to the Second Canadian and International Good Roads Convention and Exhibition. Further, it is designed to appeal to every municipality and to every good roads man in the country.

The Good Roads movement is not a movement promoted by a limited few, or by a limited association or associations: it is a national movement, and every good citizen in Canada should identify himself with it.

We are apt to think that the Good Roads movement belongs to the twentieth century, but in point of fact it is as old as the hills—an appropriate simile, perhaps. The old Roman Empire—one of the greatest and proudest the world has known—was built up by men who realized the vital importance of providing adequate transportation facilities; and their work was lasting: their highways survive to the present day.

A B.C. Man's Tribute to the Empire Number

**South Vancouver,
March 10, 1915.**

Editor Contract Record:

The Empire Number of The Contract Record is an excellent edition. I have spent considerable time looking over the advertisements, and I am persuaded that if Canadians would spend their money in Canada or the Empire they would benefit considerably.

The matter relating to municipal engineering is of special interest, and you are to be congratulated upon having collected so much useful information—from the viewpoints of both the manufacturer and the purchaser.

It must ever be our aim to produce such materials that the brand of the Maple Leaf will stand for reliability in manufacture and excellence in the product.

Yours very truly,
S. B. BENNETT.
(Municipal Engineer).

In Canada we have an empire within an empire, and it augurs well for the future of that empire that the part we are taking in road work places us in a position of national prominence. It is gratifying indeed to note the truly international character of this important congress at Toronto. It speaks well for us that our efforts have been such as to attract the attention of our good friends on the other side of the border. It is particularly significant when such prominent men as Mr. George W. Tilson, Colonel Sohier, Major Crosby and the various State Highway engineers can be gathered together in Toronto just as representatives of all nations have been gathered together in the great cities of the Old World.

Whatever curtailment of constructional undertakings there may be, there should be—and there must be—no shortening of the road programmes, for road work is not only one of the really vital issues of the country, but it is one of the most practical methods of furnishing labor for the rank and file of the working community; moreover, labor and materials are to be had in abundance, and there could never be a more opportune time for putting comprehensive schemes into effect. For years the country has been particularly active in railroad work, and now that much of this construction has been completed, or nearly completed, the activity may well be diverted to good roads. Without roads as feeders the great railways can never fulfil their destiny.

The part played by Eastern Canada so far has been a creditable one. Ontario has a programme which involves an expenditure of thirty million dollars and Quebec one of fifteen million dollars. There is a movement on foot promoted by the Ontario Motor League to construct highways from Montreal to Windsor and from Prescott to Ottawa. Work has begun on the Toronto-Hamilton road, and in Quebec a macadamized road is being built from Rouse Point, N.Y., through Montreal to Quebec—a distance of 240 miles.

We may well set aside this week to learn all that we can from the many distinguished speakers who will address the meeting. Doubtless we shall hear of the prosperity which has marked the completion of the State roads in New England, New York, and elsewhere.

In road work, particularly, we should take our cue from the older countries. We can learn much from the United States, and perhaps more from Great Britain and other countries of the Old World. Most of all, surely, we can learn from our own experience that all the constructional enterprise, all the industrial development, all the work of the farming community, depends upon transportation facilities for its consummation. Good roads first, and good roads last. Posterity can pay us no greater tribute than we pay the Romans—"They built good roads."

President McLean

NO greater misfortune could have overtaken the Second Canadian and International Good Roads Convention than the regrettable illness of the President, Mr. W. A. McLean whose indisposition is of such a serious nature that he will be debarred from taking any part in the proceedings.

For some years now Mr. McLean has labored in season and out of season to promote the cause of good roads, and his labors have been conducted so efficiently, and withal so unobtrusively and wholeheartedly, that he has not only made a reputation for himself as an engineer, but he has endeared himself to countless of his friends as a genial good sort.

Mr. McLean is an Ontario man, and has had an extended connection with road work. It is nearly twenty years since he entered the service of the province as assistant to Mr. A. W. Campbell—"Good Roads" Campbell," as he was called—Commissioner of Highways. He has made good use of that twenty years—such good use that he has come to be regarded as one of Canada's leading authorities in his special field—a fact which is attested by his election to the important office of President of the American Road Builders' Association, over whose destinies he presided last year.

Mr. McLean has a wide circle of acquaintances amongst road engineers, not only in Canada and the United States, but in England. We recall meeting him in 1911 at the Third International Road Congress in London, a convention which was attended by some two thousand engineers, representing upwards of forty nations.

During the period of Mr. McLean's administration the road-building activities of the province have gone forward by leaps and bounds. On another page Mr. McLean himself gives a few of the details of these activities—which run into more than thirty million dollars.

We know that one and all of the delegates to the Second International Good Roads Convention will join with us in expressing our sympathy with the President in his disappointment. For some weeks Mr. McLean had been planning the reception and entertainment of the visitors from the United States, and the loss of the Convention will be nearly as great a blow to the President as the loss of the President will be to the Convention.

Good Roads in Western Canada

IT is gratifying to find that the question of Good Roads is becoming a live issue in Western Canada and that the authorities are taking the lead in inaugurating enterprising constructional measures. Difficulties in the way of transportation are perhaps the most serious that the Prairie Provinces have to contend with. It is not only that the railway facilities are inadequate in the matter of equipment and in the handling of traffic: it is that better roads are needed. In many of the rural districts the rough tracts which pass as highways are practically impassable in wet weather, and for many months each year a great barrier is raised between the farmer and his market.

It is gratifying to note the resolution—recorded elsewhere in this issue—of the Manitoba Good Roads Association to hold their Conventions annually. In their request for the assistance and encouragement of the authorities they have our best wishes.

The ratepayers of Western Canada realize that no factor in the development of the agricultural resources is more potent than the construction of good roads, and consequently they are willing to sanction considerable expenditures in this field. In Manitoba, the movement has been given an impetus by the establishment of a Good Roads Board, which has been appointed to direct the expenditure of the $2,500,000 provided for under the Act for assisting the various municipalities in building such roads as may be considered the main market roads.

Good roads in Western Canada will do much to remove the obstacles between the prairie dweller and progress; and by increasing the productive capacities of the Canadian West we are doing a great work for the prosperity of the whole country. It is therefore very gratifying to note that the policy of the Provincial Government of Manitoba and of the Good Roads Board is to promote the cause of good roads as much as possible. It behoves every municipality to further the policy by instituting an active campaign for market roads. Certain it is that Western Canada could not invest its money to better advantage.

An Unfortunate Connection

SOME time ago we received a communication from a correspondent in which "damned little dots" were referred to as the bugbear of engineering reports. The same effective manner of description may be applied to the typographical errors which are the bugbear of journalistic work.

In our issue of March 10th we published a particularly able letter written by Mr. Paul Seurot, the Montreal consulting engineer, who discussed our Symposium on "The Possibilities of Developing Trade within Canada and the Empire." In paying tribute to Canada's great natural resources, Mr. Seurot referred to the fact that Canada had been called "the granary of the world." Whether by design or intent, by the application of an exaggerated sense of humor, or by sheer carelessness, the linotype man rendered this "the Germany of the world"—and this unfortunate phrase happened to escape the censorial eye of the proof-reader.

Mr. Seurot suggests that the proof-reader must have had designs upon him, but we think not. Mr. Seurot is too good an Imperialist to be suspected of any form of espionage calculated to establish relations between Canada and Germany at such a time as this.

Such errors are regrettable, but occasionally unavoidable. They are annoying—but interesting, as showing that not even The Contract Record and Engineering Review can lay claim to infallibility.

Contract Procedure at Montreal

A point of considerable interest to contractors has arisen over the letting of a contract for a civic library at Montreal. The conditions called for the names of the sub-contractors to be inserted in the tender. In the case of two tenders these were omitted, and the question arose as to whether the tenders were in order. At a meeting of the Board of Control a protest was made by Messrs. E. G. M. Cape, Limited, the second lowest bidders, to the effect that it was impossible for a general contractor to do the work without sub-letting. Mr. John Quinlan, the lowest bidder, assented, however, that he was able to do all that was required without sub-letting, and his financial deposit was there as a guarantee. Mr. Quinlan had omitted the names of any sub-contractors.

On an inquiry being made as to how he intended to instal the elevators, Mr. Quinlan replied that the specifications called for one kind, and he would buy them, and put them in. "My interpretation of a subcontractor," said Mr. Quinlan, "is a firm which works on a building under a general contractor."

Provided Mr. Quinlan gives a guarantee that he is able to carry out the contract, the City Attorney has ruled that Mr. Quinlan's tender is in order. The question of letting the contract was left over.

The architect, Mr. E. Payette, states that in the purchase of material first preference has been given to Canada, next to Great Britain, and third to France.

The granite block pavement in Astor Place, New York, N. Y., is being cited by advocates of that type of pavement as an example of the excellence of granite blocks laid under the improved specifications now in force in the city of New York. The pavement was completed in 1911, and it is stated that it is now in as good condition as upon its completion and that, in spite of the very heavy traffic which it has to bear, it shows no perceptible sign of wear. It is also stated that there has been no expenditure for maintenance on this particular pavement, and that, as no street openings have been made since the pavement was laid, an ideal opportunity is given to note its wearing qualities and its behaviour under traffic.

Location surveys on 2,063 miles of state highways in California have been completed, according to a recent report. It is also stated that 1,063 miles of roads are either completed or under contract and that awards are pending on a large additional mileage.

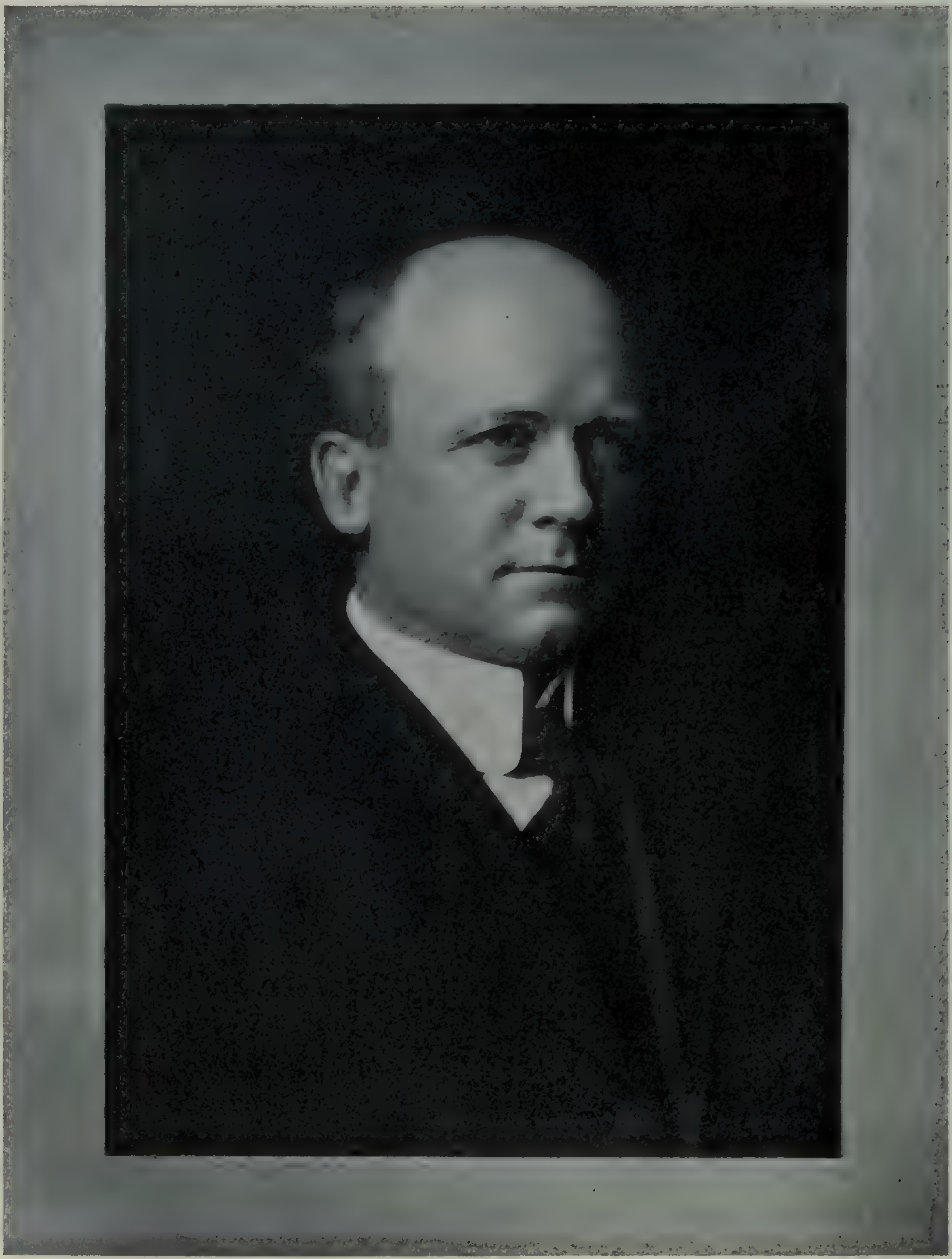
Service First

THE Contract Record is designed primarily as a service manual. It is not a text-book, and for this reason elaborate mathematical deductions and formulae seldom figure in our columns. Formulae are given only where required to establish the connection between the theoretical and the practical. We specialize in practical, helpful information. Our motto is "Service First."

We wish to emphasize this principle, and with a view to doing so we invite our readers to take full advantage of the facilities of our Service Department, which takes charge of all inquiries submitted to The Contract Record. Engineers, architects and contractors frequently write us inquiring for names of the manufacturers of certain lines of constructional material. Frequently manufacturers write to us for information concerning impending contracts or current work. We welcome all such inquiries, and we place at the disposal of the reader the accumulated facilities of a publication which has been established thirty years.

In our issue of March 22nd, 1890—twenty-five years ago almost to the day—we find the record of a resolution by the Ontario Association of Architects pledging the members of that body to use this journal as their medium of communication with contractors. They signified their approval of The Contract Record at a convention held in Toronto on November 20th and 21st, 1889—**before some of us were born!** It need only be said that the facilities of The Contract Record and Engineering Review have increased proportionately with the general growth of the paper in the last quarter of a century. The paper is the established medium of the engineering-contracting and general constructional interests in Canada.

The Contract Record was the pioneer in its field, and it maintains its position of pre-eminence by adhering closely to the policy of "Service First."



President McLean
Chief Engineer of Highways for Ontario and President of the Road Congress

Highway Construction in Canada

By W. A. McLean, Chief Engineer of Highways for the Province of Ontario; President of the Second Canadian and International Good Roads Convention

HIGHWAY construction is, in the aggregate, one of the largest undertakings which the development of Canada demands. The common roads now in use have a length of about 250,000 miles, and the total expenditure required for bridges, culverts, grading, draining and surfacing will necessarily amount to many millions of dollars. The road problem of today has to do with all roads—not only the trunk roads running between cities and towns; nor the leading market roads radiating from towns and shipping points; nor the side lines which carry the limited amount of traffic originating on them; all classes of roads must be considered—the main roads, the market roads and the feeders, so that every citizen in every district may have an opportunity to produce and sell, and thereby, from the illimitable resources of the soil, build up the material wealth of the country.

Canada has splendid harbors from which to engage in world commerce, and she has a magnificent waterway of river, lake and canal, reaching to the heart of the Continent. Railway construction has made excellent progress, and little more need be attempted in that direction for the present. The important need now is for existing railways and waterways to be fed with the greatest possible amount of traffic, and that can best be brought about by the improvement of their natural and necessary feeders—the network of common roads.

Steam railways do not lessen but rather increase the need for good wagon roads. Among the first common roads to demand improvement are those carrying electric railways. Electric railways and steam railways do not lessen—but invariably increase the need for improved highways. Good roads, available for traffic of horse-drawn and motor vehicles, afford a freedom and flexibility with which railroads cannot compete. In the larger sense they are not rivals, for each is necessary to the other.

Provincial and municipal governments throughout Canada are addressing themselves seriously to the problem, and the next decade promises a very large increase in the mileage of good roads. The total expenditure on roads and streets in Ontario, provincial and municipal, amounts to nearly $10,000,000 annually, while the Provincial Government has under consideration a comprehensive plan involving an outlay of $30,000,000. The Provincial Government of Quebec, under an Act of 1912, voted $10,000,000 for main roads and this year has made an additional appropriation of $5,000,000. British Columbia, Alberta, Saskatchewan, and Manitoba in the west are making substantial expenditures; New Brunswick, Nova Scotia and Prince Edward Island are active in the work.

Road building for many years, under purely township control, was a matter of clearing the road allowance, with a certain amount of grading and draining—all carried out in a small way, commonly described as "fixing" the roads. The day for "fixing" the roads by statute labor and similar means is passing rapidly. Substantial work is now required to meet the needs of heavy and increasing traffic. Economy now dictates that road-building shall be carried out in long stretches by the use of machinery and labor-saving equipment. It has become a man's work, to be carefully organized and directed, so that economy and efficiency will be obtained. The large amount of literature now being published on the subject is some indication of the importance of highway management as a specialized branch of civil engineering—one urgently needing the best training and experience which can be brought to bear on the work, in order that the expenditure now being devoted to roads may bring about the best results.

Hon. Finlay Macdiarmid
Minister of Public Works for the Province of Ontario

The Hon. Finlay Macdiarmid

Minister of Public Works for Ontario

Upon Whom Falls the Responsibility of Administering the Comprehensive Road Policy of the Province

THE Hon. Finlay George Macdiarmid, Minister of Public Works for Ontario, has always taken an active interest in the development of the good roads policy of the Government. He was one of those who pressed for greater appropriations for the purposes of improving the highways of the province, and he identified himself with the organization of the County Good Roads systems. While others became impressed by what had been accomplished, Mr. Macdiarmid concerned himself with what remained to be done. He realized the growing needs of Ontario, and carried his colleagues with him in his views as to its requirements. The broader his range of view, the wider his horizon of action.

Ontario's Minister of Public Works has characteristics which make him invaluable in the constructional sphere. Opposition to any proposal stimulates his best efforts, and his Scotch tenacity keeps him hanging on and hammering away when his opponents appear to be getting the advantage. His responsibilities are of a varied character. Directly under his control are the public buildings of Ontario, which have a value of something over $20,000,000. He has the oversight of matters concerning the Commission and the Temiskaming and Northern Ontario Railway. He devotes part of his attention to fish and game, from which the yearly revenue of the province is about $160,000. During the last few months he has supervised the expenditure of $180,000 on public works and drainage. This amount brings the outlay of the province up to $3,050,000 in this class of work. On colonization and mining roads last year—work which was carried out under his supervision—something like $800,000 was spent. Among the public buildings under his eye mention may be made of the Government House, Toronto, which is costing nearly $1,000,000, and the new Hospital for the Insane at Whitby. Mr. Macdiarmid has stood behind Sir Adam Beck in the development of the Hydro-Electric system, which has saved millions of dollars to the people of the province.

Under the administration of the Hon. Mr. Macdiarmid, it is fair to assume that the constructional development of Ontario, in which road building figures so largely, will continue apace.

Mr. Macdiarmid was born at New Glasgow, N.S., in 1869.

The Status of the Good Roads Movement in Manitoba

Specially Contributed by A. McGillivray, Highway Commissioner of Manitoba

THE problem of providing good roads in the rural municipalities of Manitoba is receiving the considerate attention of municipal councils and the Government of the province. The ratepayers also, realizing that no factor is more potent in the development of the agricultural resources of the province than the building of good roads, are willing to permit of larger expenditures being made towards their attainment.

The "Good Roads Act" of this province, under which liberal assistance is given to the municipalities in building leading market roads, has also been instrumental in giving an impetus in the last two or three years to this very important undertaking.

A "Good Roads Board" consisting of three members has been appointed to direct the expenditures of the $2,500,000 provided under the "Act" for assisting the various municipalities in building such roads as may be considered the main market routes of a municipality. This work is conducted through the agency of the Municipal Council and is assisted by the engineers of the "Board." All improvements made are done to standards, under specifications prescribed by the "Good Roads Department." The financial assistance contributed by the Provincial Government is one-third of the cost of constructing earth roads and one-half the cost of gravel or other improved types. One-half the cost of permanent bridges and culverts included in a "Good Roads" system adopted under the "Act" is also contributed by the Province, and one-third of the cost of bridges and culverts not included in such a system is given. The maintaining of all roads constructed under the "Act" devolves on the municipality, and the cost thereof is wholly borne by them, the Government having statutory power to perform this work and levy against a municipality that neglects to perform such necessary work.

About two hundred miles of improved roads were constructed under the "Act" last season, including the erection of twenty-two reinforced concrete structures. This work was done at an expenditure of about $325,000. No doubt a much larger mileage would have been completed had it not been for the outbreak of the European war.

The absence of suitable road materials in a great many districts of this province will preclude in places so situated the construction of a large mileage of hard surfaced roads. But where gravel or stone is at all convenient, these materials will be employed extensively, especially on the main highways. The earth road, therefore, will be the most common type in this province for many years.

It is the policy of the Provincial Government and of the "Good Roads Board" to endeavour to further the idea as much as possible; "that the Municipality should exert every effort in establishing systems of market roads, whereby every farmer will be placed within reasonable distance of a good road, over which he can reach his market with the produce of his land."

These roads will certainly be of more benefit to the farming communities—which comprise by far the largest portion of the organized part of the province—than the building of main through roads. Although considerable agitation—especially by the motorist and motor trades people—has been put forth for the construction of provincial highways that would connect the large centres of population, it is apparent that the best interest of the province would be served by following the method outlined above, and that by extending these markets as time went on, and as necessity demanded, a connection would be made that would ultimately result in a provincial-wide system.

It is expected that a very considerable amount of good permanent work in road building will be done during the coming season, regardless of the existing abnormal conditions, although it is obvious that the amount will not reach the proportion it would have done had conditions been otherwise. Nevertheless, interest is rife in this province in connection with this very important question of securing better roads and the best means and energy of the people will be employed towards their attainment.

The First Manitoba Good Roads Convention at Winnipeg

IN our last issue we gave a brief report of the Road Congress held recently at the Manitoba Agricultural College, Winnipeg. This Convention was one of the most successful of its kind ever held in Western Canada—evidence of which is found in the fact that over one hundred and fifty delegates, representing the different municipalities of the province, and including engineers from all parts of Canada and the United States, were in attendance. Many interesting addresses were given at the various sessions.

Mr. J. H. Mullen, Deputy State Engineer of Minnesota, dealt with the question of "Dirt Road Construction and Maintenance." He said there were 93,000 miles of roads, of which 80,000 were earth roads. More attention should be given to dirt roads, as of necessity they would be an appreciable factor for years to come. Proper location was an important thing in road construction. Where heavy grades were encountered on the existing trail a new survey should be made and the road put through without regard to these lines. Governing considerations should be the volume of traffic, the limiting of grades, and the safety of the travelling public. The maximum grade should not exceed five per cent., and grade crossings should be eliminated wherever possible. Sufficient crown should be provided. The speaker recommended a 20-ft. crown and a 2-ft. ditch. In the Red River Valley gumbo roads had been covered with a top dressing of fine sand gravel, put on to a depth of three inches and allowed to mix thoroughly with the gumbo. The placing of gravel on roads to a depth of more than three inches was a mistake, as the gravel would hold the moisture in the road and thereby cause heavy rutting. A continuous system of dragging after construction was necessary, as the passage of the drag set up a puddling action which eventually formed a surface impervious to water. On the dirt road effective work was done as the frost left the ground. Mr. Mullen stated the average cost of dragging at from $10 to $12 per mile per annum.

An interesting address on "Road Dragging and the Importance of Maintenance" was given by Mr. S. R. Henderson, President of the Manitoba Good Roads Association, who emphasized the value of the split log drag, and expressed the opinion that competitions should be encouraged by municipalities.

"Gravel Road Construction" was the topic of an address by Prof. Agg, of Iowa, who stated that the best method of applying gravel was to place it in two layers, the first or lower course 9 ft. to 10 ft. wide, and the upper course 15 ft. wide. This would have the effect of giving a heavy centre dressing and leaving the outer part only 4 inches to 5 inches thick. It was essential, said the speaker, that the roadbed should be in good condition before the application of the gravel and that it should be kept dragged until the action of traffic had compacted it.

Mr. A. McGillivray, Highway Commissioner for Manitoba, dealt with the question of financing road construction. He advocated market roads as a means of developing the country more quickly than by the building of main roads. In this view Mr. T. R. Deacon, Ex-Mayor of Winnipeg, concurred, touching also upon the desirability of providing for maintenance out of capital.

Prof. Mullens, of Minnesota, discussed macadam roads, and commented upon the increasing use of soft rock in place of hard stone due to the fact that the traffic tended to crush the rock and compact it more readily.

Mr. P. P. Sharples, of New York, gave an illustrated address entitled "The Hard Surfacing of Roads." A number of excellent views showed machines for laying road material and spraying on tar and bituminous material. Many fine examples of macadam roads had been treated with tar binders, said Mr. Sharples. The pictures included a series showing the construction of a road from the time the material started from the quarry until it was in place in the completed road. Later a further address on "Low Cost Roads" was delivered by Mr. Sharples.

Mr. W. F. Tallman, Street Commissioner of Winnipeg, presented a paper on "Country Roads." In this paper attention was drawn to the following important points: first, the location of the road with a view to making the construction as cheap and economical as possible; second, the roadbed; and, third, the surface of the road. Stumps, rocks, etc., should be removed before grading, and on no account should any perishable matter be allowed to enter into the material out of which the surface was formed. Where the road was dry trees should be left on either side, but where conditions were adverse in this respect the trees should be cut away so as to allow of the evaporation of the moisture. The sub-grades should be carefully harrowed, and rolled, if possible. Ditches should be made carefully and any rut-holes or breaks in the surface should be repaired immediately if it was the intention to have a road that would last well and cost the minimum for maintenance.

The Manitoba Highway Commissioner, Mr. McGillivray, gave further information in regard to general road conditions and the methods to adopt under varying circumstances, impressing on the delegates the necessity of taking the engineers into their confidence and telling them of any troubles encountered, so that they would all be familiar with the requirements of the situation. Completed road work should include permanence of location, adequate drainage, good foundation, and a surface covering to meet the demands of the traffic so as to ensure proper facilities for transportation and intercommunication at a low cost.

At the closing session a resolution was passed in favor of asking the Government to take an active part in the arrangement of these conventions, particularly with a view to securing adequate publicity for the work and distributing the benefits among all the municipalities of the province.

Spring Work on the Earth Roads

WITHIN a short time the frost will be out of the ground throughout a very large area. When it comes out it will leave a majority of the earth roads in a rough, badly rutted condition, and in most communities some attempt will be made to "work" the roads. The manner in which this work is done is a matter of the greatest importance.

There are many ways of performing spring work on the earth road. One of these, and, unfortunately, one of the most common, is to wait until the road has thoroughly dried out and then go over it with a road machine, scraping out the ditches and bringing to the centre of the travelled track leaves, sods, twigs, roots, stones and all the debris which has accumulated there since the last "working." That this method of using one of the most valuable of machines is entrely wrong should be patent to anyone having the most elementary knowledge of road construction and maintenance, for one of the first principles of the road builder's art is to keep such material as far away as possible from the surface of the road. Yet it is a fact that exactly the method described is in very common use in many places.

The road machine, more definitely described as a road grader or scraping grader, is a very useful machine, and one which can be used to advantage on the earth road for cleaning out the gutters and for regulating the surface of the travelled track when that surface is so uneven as to require such treatment. It is not being used to advantage, however, when it is employed in the manner referred to in the preceding paragraph—rather is it being abused. Nor is it the only machine or appliance necessary for the maintenance of the earth road.

An appliance that has found extensive use and that, when used intelligently, has invariably given satisfaction, is the road drag. This appliance may be made from a log or a piece of heavy timber, or may be purchased at a small cost from a number of manufacturers under the name of drag, hone or leveller.

The road drag, used at almost any time when the road surface is wet, will smooth the surface by scraping off the ridges and depositing the material therefrom in the ruts. By operating it in such a manner as to give the road the necessary crown it is possible to provide for the quick drying out of the road after a rain by the shedding of the water to the ditches, which should, of course, be cleaned out and deepened when necessary. The drags may be operated by farmers living along the road, with whom the township authorities can often make contracts to do the work for comparatively small compensation. This plan has been followed in many places, with very satisfactory results. It is also feasible to use automobiles to haul the drags, a plan which has also been tried and found satisfactory.

The primary requisite in the maintenance of earth roads is to keep them dry, and to do this the water must be kept off the road and out of the road. The first can be done by keeping the surface smooth enough and sufficiently crowned to shed the rainwater to the ditches. The second can be accomplished by providing ample side drainage and efficient underdrainage. The side drainage can be cared for properly by ample ditches and culverts, the whole object of the drainage system being to get the water as far away from the road as possible, as quickly as possible. This is also the object of underdrainage. This, of course, should be taken care of when the road is built, by using a foundation that dries out quickly, when possible, or by installing drains under the roadway. In many cases in which proper provisions for underdrainage were not made when the road was built, it would be possible and economical to build underdrains in some of the places where they are found to be most necessary after the road has been built and in use for some time. Such bad spots in the roads can readily be located in the spring of the year, as they will be the last to dry out.

The work that is done in the spring will very largely determine the character of the earth road during the summer to come, and too much care can not be taken in its performance.—Good Roads.

Road Progress in Quebec and an Outline of the Road Policy of the Province

Specially Contributed by B. Michaud, Deputy Minister of Roads for Quebec

According to the Municipal Code, the making and maintenance of roads and by-roads is, with certain exceptions, under the control of the local municipalities. The main fault with the system was that roads were maintained by land owners or by statute labor; consequently there was practically no direction. However, Article 535 of the Municipal Code states that a municipal council can take charge of the maintenance of roads. In order to induce the municipal councils to do so, the Government put through an Act by virtue of which municipalities taking charge of their roads are entitled to a yearly subsidy ranging from $100 to $400. The same Act authorizes the Government to grant subsidies equal to $1,000 for macadam or $500 for gravel, besides the grant above mentioned for maintenance. That policy brought good results. As a matter of fact, out of 1,100 local and rural municipalities, nearly four hundred have put their roads in charge of the corporation since 1907-08. A certain number of municipalities also took advantage of the Government's offer as regards macadam and gravel. Previous to 1907, the Government offered certain subsidies to municipalities wishing to buy road graders. Under the Good Roads Act of 1911, machinery (road graders) can also be bought and the price included in the yearly statement of expenditure for maintenance. Besides, the Government had purchased a certain number of macadam outfits that were put at the disposal of the municipalities, together with an instructor; that is, a man to supervise and direct the construction of macadam.

Mr. B. Michaud*

All this organization is still in force, but in 1912, seeing that a great number of municipalities were deterred from building macadam by the insufficiency of the grants as compared with the expenditure involved, the Government devised its new policy of loans, the proceeds of which are allotted to municipalities in amounts sufficient to cover the whole cost of the work done.

The Good Roads Act of 1912 provided for a loan of $10,000,000. This amount has been increased to $15,000,000 during the last session. Since the coming into force of the Good Roads Act of 1912, allocations have been made to 296 municipalities for macadamizing or gravelling. Those municipalities have built about 525 miles of macadam and 135 miles of gravel. The Government has also allocated to 143 local municipalities amounts varying from $6,500 to $7,000 for the purchase of road outfits. As already stated, it has been left to the local municipalities themselves to take advantage of the Good Roads Act of 1912. Some were of opinion that such a policy would not bring the results contemplated, that scattered municipalities would build only scattered pieces of roads, and that, consequently, the Province would not have continuous stretches available for modern traffic. Facts have proved otherwise. Effectively, in several parts of the province, there are stretches varying between five, ten and fifteen miles built by municipalities. However, the Government, at the very beginning, met the objection and decided to build trunk roads between the important centres of the province, as well as between such centres and important points at the boundary.

What will be our policy in the future, it is not easy to tell in detail, but I may say that the main features will be what they are now, that is, a close attention to the general interest of the farmer, without disregarding the legitimate requirements of modern traffic. In order to carry out this programme, we direct our road improvement so as to make it adequate to the resources of the province, to the traffic of the different districts or localities and to the natural facilities offered by such districts or localities as regards the material available.

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*Mr. Michaud, the Deputy Minister of Roads for Quebec, takes a keen interest in national movements such as that promoted by the Toronto Convention, and is scheduled to speak on the subject of Road Laws. He has been connected with the Department of Agriculture of the Province of Quebec since 1897, and became Deputy Minister of Roads in 1912. Mr. Michaud was born in 1874.

One Cause of the "Inferiority" of City Pavements

IN a lecture entitled "Some Causes of Bad City Pavements in America and Their Remedy," delivered at the recent road school at the University of Ohio, Professor Leonard S. Smith of the University of Wisconsin stated that "the marked inferiority of American city pavements as compared with those of European cities is certain to impress even the most casual traveller." He contends that an investigation will show that this inferiority is usually not due to a lack of knowledge or skill in design or construction, but is the result of several unwise customs.

These faulty customs, according to Professor Smith, who has charge of the Highway Engineering Department of the University of Wisconsin, are: (1) The selection of the wrong type of pavement; (2) the lack of a systematic paving and street improvement program; (3) a faulty city street plan; (4) inadequate inspection of construction, and (5) the general lack of an adequate system of pavement maintenance.

Professor Smith spoke in part as follows:—

"In view of past experience, it must be admitted that the custom of allowing the abutting property owner to decide the type of pavement for his street is wrong both in theory and practice. Such a choice is very likely to result in the rapid destruction of the pavement so selected because not suited for traffic conditions. In the end it is an unnecessary burden upon the shoulders of the general taxpayer because of the resulting high annual maintenance cost.

"Property owners who never would consider themselves qualified to decide the kind and size of sewers or the water pipes in front of their homes, strange to say, appear very confident of their ability to pass on the type of pavement suited to their own street. The fact that their interest in pavement matters is generally limited to their own street suggests that considerations for their own pocketbook alone form the basis of their expert knowledge. This is especially true where the property owner pays fof the first pavement only and the city pays for all renewals and repairs. Under such circumstances the landowner is apt to select the cheapest pavement—that is the smallest first cost—even though the cost of maintaining such a non-suitable pavement be many times in excess of a reasonable charge. In some American cities excessive maintenance charges, due to this system of selection, have resulted in the practical abandonment of such pavements so that they are soon full of holes.

"Then, too, a certain type of salesmanship possessed by some agents of paving material concerns has greatly stimulated the property owners' confidence in their expert knowledge, thereby greatly complicating the situation. Not infrequently the controversies aroused by the active solicitations of such agents have prevented a wise choice of pavement, with the result of bad pavement conditions. Obviously in the long run such agents are not serving even the best interest of the companies they represent.

"The speaker does not wish or intend to belittle the thorough-going and bona-fide investigations of pavement matters by citizen organizations. In fact, under our democratic form of government such movements are of real necessity for informing the general public and thereby securing its confidence and co-operation with the plans of the city government. The speaker is fully aware of the excellent results secured by this important type of team play between citizens and their chosen administrative officers. The best results in such cases, however, have been realized through the employment of experts by such citizen organizations to investigate the facts and report to the citizens their conclusions, with full statement of reasons. Some of these reports distributed in the form of bulletins have contributed greatly toward the cure of pavement evils by pointing out their proper remedy. We need more, not less, of this form of team play. The selfish practices which I am condemning are obviously so poorly calculated to serve the general welfare of the city that no one really attempts their defense. In fact, many cities select their pavements now on expert advice alone. Such cities have learned to put great weight upon the recommendations of their city engineer, based as they are upon large experience and adequate investigation. We can confidently expect that our growing vision of municipal efficiency will not much longer tolerate the old system of pavement selection by selfish interests."

Convict labor on the highways of Warren County, New York, has been used successfully during the past year, according to the annual report of County Superintendent of Highways B .E. Murray. It is reported that convicts were used in the towns of Hague and Warrensburg on work in addition to the regular road work performed by local labor. Superintendent Murray states that this work would not have been done had convict labor not been available, so that the complaint made at first that free labor was deprived of work by the convicts was without foundation. He recommends in his report that all of the towns in the county put in applications for prisoners to be used in the spring.

From a Sand-Lime Brick Manufacturer

Calgary, March 16, 1915.

Editor Contract Record:

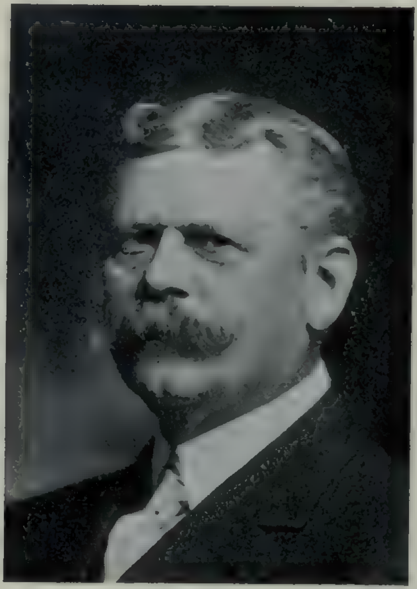
Without discussing in detail the merits of the individual articles published in your British Empire Number, I may say that I regard the whole issue as an encyclopaedia of information, not only on the province in which it is edited, but in the wider application of Canada and the Empire. I have read it through and have been much impressed with the many interesting letters from city engineers, architects, and others. The article by W. J. Whiteside was very interesting, but I am wrong in making mention of any one letter or article. The whole book is good.

The many advertisements, with their clear-cut illustrations, attest the high standard of your paper.

Yours very truly,
G. SILVESTER.

Distinguished Speakers at the International Road Congress, Toronto

Major W. W. Crosby, Consulting Engineer, Baltimore, Md.



Mr. R. A. Meeker, Trenton, N. J., State Highway Engineer of New Jersey.

Mr. Arthur R. Hirst, of Madison, Wis., Chief Engineer of the Wisconsin Highway Commission.

Col. W. D. Sohier, of Boston, Chairman of the State Highway Commission of Massachusetts.

Leading Men at the Road Congress

A Few of the Distinguished Visitors at the International Good Roads Convention, Toronto, March 22 to 26, 1915

Major Crosby, of Baltimore

MAJOR W. W. Crosby, the Baltimore, Md., consulting engineer, who is to address the Convention on Wednesday afternoon on the subject of Dust Prevention, has an international reputation as a good roads expert and enthusiast. He graduated from the University of Maine with the degree of B.C.E. in the year 1893, and received the degree of C.E. three years later. In 1912 the Maryland State College awarded him his D.Sc. For ten years (from 1887 to 1897) he was engaged in general engineering practice. In September, 1897, he was appointed Resident Engineer for the Massachusetts Highway Commission, and since that date he has devoted his untiring energy to the interests of road work. He became Roads Engineer for Baltimore County, Maryland, and was afterwards General Superintendent for the Board of Park Commissioners, Baltimore. From May, 1905, to date he has been Chief Engineer of the Maryland Geological and Economic Survey in charge of State Aid road work. He rendered excellent service for some years as Chief Engineer of the State Roads Commission of Maryland. He has been in private practice as a consulting engineer since July, 1912. In point of fact, the scope of Major Crosby's activities has been too wide to cover in the short space available in this issue. He has been Non-Resident Lecturer in Highway Engineering at Columbia University, Instructor in Charge of Extramural Courses in Highway Engineering at New York University, and Non-Resident Lecturer in Highway Engineering at the Universities of Michigan and North Carolina. As an official delegate he has attended international road congresses at Paris in 1908, at Brussels in 1910, and at London in 1913. He is a member of the leading technical societies of the United States, and is the author of many official reports and technical articles dealing with highway engineering.

Under the direction of Major Crosby, road work in Maryland received a great impetus during the twelve years that he held office, plans having been prepared for work covering expenditures of over ten million dollars, of which more than eight million dollars' worth was actually completed. The variety of this work was unusually great, as the work comprised not only State Road and State Aid road construction, but also the improvement, according to modern methods, of streets in many of the towns and cities of the State, and in Baltimore City itself. The State Road Law provided for the expenditure of about two million dollars from the funds for the improvement of the ends of the State roads lying within the corporate limits of Baltimore City, and this intra-city work was of the highest and most modern type. It included vitrified brick, sheet asphalt and stone block pavements, laid in many cases contiguous to street railway tracks—which necessarily had to be rebuilt largely.

Mr. Arthur R. Hirst, of Madison, Wis.

MR. Arthur R. Hirst, of Madison, Chief Engineer of the Wisconsin Highway Commission, who on Tuesday afternoon is going to tell the Convention how they build roads in the State of Wisconsin, is a civil engineering graduate of the Maryland Agricultural College. He was with the Maryland Geological Survey from 1903 to 1907. For four years he was Highway Engineer of the Highway Division of the Wisconsin Geological and Natural History Survey. He was appointed to his present office in 1911.

Mr. Hirst has charge of all State Aid road and bridge work in Wisconsin, where in three years the sum of nearly seven and one-quarter million dollars has been expended. Altogether, Mr. Hirst has been identified with the construction of roads and bridges involving the expenditure of eight and one-half million dollars.

The State construction in Wisconsin includes everything from the building of earth roads in the more unsettled portions of the state, to the highest class concrete, vitrified brick, and sheet asphalt pavements in Milwaukee county. Conditions in Wisconsin are quite similar to those prevailing in portions of Canada, and Mr. Hirst's illustrated talk on road and bridge construction should be of much interest.

Mr. Robert A. Meeker, of Trenton, N.J.

MR. Robert A. Meeker, of Trenton, N.J., is one of the prominent speakers at Toronto this week. He has been in charge of road work for the last twenty-seven years, and was appointed to his present position in 1900. It is his official duty to supervise and inspect all plans, profiles and cross sections prepared by the several county engineers of the State. No grants of State aid are made until the plans for such improvement have received his approval.

New Jersey appropriates $500,000 per annum to pay its 40 per cent. of the cost of new work; therefore, construction to the value of at least $1,250,000 is begun each year. The State's appropriation is also used to pay 20 per cent. of the cost of new bridges built on the line of the new work. The proportion of bridge work done brings the annual expenditure for roads and bridges up to $1,400,000. All of this design, as well as the construction, is subject to Mr. Meeker's supervision.

New Jersey collects over $781,000 from motor vehicle licenses and fines. This fund is used for the repair and upkeep of roads. Upon the plans for this work also the State Highway Engineer is called to pass.

Mr. Meeker holds membership in The American Road Builders' Association, and in The American Society of Civil Engineers.

Col. Sohier, of Boston

COL. W. D. Sohier, of Boston, who will speak on Traffic on the afternoon of Thursday, March 25, is Chairman of the State Highway Commission of Massachusetts. Born in 1858, he was educated in public and private schools, and proceeded to the Harvard Law School after spending a short term in the Massachusetts Institute of Technology. He was admitted to the Bar in 1881, and he was a member of the Legislature from 1888 to 1891. He has been actively connected with road construction for a quarter of a century. In 1906 he interested himself in the application of oils and dust-layers. He was appointed to the Massachusetts Highway Commission in 1908, and succeeded Mr. Harold Parker as Chairman of that body in 1911, retaining the office ever since.

The Massachusetts Highway Commission, be it noted, consists of three members. It has been in existence for twenty-two years. Massachusetts has perhaps the largest proportionate mileage of good roads of any State in the Union, and is now spending one million dollars a year for the construction of State highways and State Aid roads. It has over a thousand miles of State highways, and more than an equal number of miles of road improved at the joint expense of the town and the State. Last year the oiling and maintenance of State highways cost some $850,000. Of the thousand miles of State highways—most of which was originally macadam—over nine hundred and fifty miles have been treated by some bituminous surfacing with a blanket coat on the top, or they have been rebuilt of bituminous macadam.

To-day the Commission is building on the main routes roads 18 feet in width, with a 3-ft. shoulder on each side. Bituminous macadam roads, and in some cases concrete roads, are being constructed. The Commission is re-surfacing about sixty miles of road every year, this work being on the old State highways, which are wearing out with the rapidly increasing traffic.

The Massachusetts Highway Commission was one of the pioneers in road building, and a high standard is maintained. The roads are kept in good shape, a section gang being in charge of from five to seven miles, keeping the roads constantly patched and repaired, gravel roads shaped, and the gutters and catch-basins clear.

The Fundamentals of Road Economics

THE fundamentals in road economics are sometimes overlooked in the search for pointers on up-to-date construction. The manner in which these fundamentals are outlined and emphasized by Mr. J. E. Pennybacker, Chief of Road Economics in the United States Office of Public Roads, is commended to the delegates to the Toronto Congress—in whose interests the bulk of the material published in this issue has been prepared.

The Fundamentals

1.—All who share in the benefits of road improvement should share proportionately in the burdens.

The country road is no longer a mere local utility. Legislation should, therefore, provide for city taxation in aid of country road improvement. Automobile owners should individually pay a material portion of the cost of our public roads.

2.—The degree of improvement should be proportionate to the traffic on the road improved.

Too often have we seen costly improvements distributed according to the dictates of a few influential citizens or according to some arbitrary arrangement of political units, or for sentimental reasons, or through a cheerful, haphazard indifference. It is now generally believed that four-fifths of the traffic of this country is carried on one-fifth of the road mileage. It should be manifest that the most heavily travelled roads should first receive attention and should be improved in the most substantial manner. It is entirely feasible to make an expert study of a country road system and indicate graphically the traffic areas for each important road so as to establish with reasonable exactness the amount of outlay which the traffic would justify.

3.—The rate of payment or the rate of accumulation of the sinking fund on any public debt contracted for road improvement.

One faction either opposes debt in any degree or contends for an indebtedness of such short term as to make it almost a cash transaction, and asserts that the road is entirely destroyed long before the debt becomes due. Another extreme faction contends for long-term indebtedness, on the theory that as posterity will reap the benefit it should bear the burdens, and that a road well maintained never wears out. As a matter of fact, location, if intelligently made, should be permanent; likewise all reduction of grades. The drainage features, if honestly and efficiently constructed, should be reasonably permanent. The road, except under extraordinary conditions, should, therefore, be considered reasonably permanent as to these features. As a general rule, the foundation of a road should not require renewal if the road is subjected to adequate and continuous maintenance. Avoiding any detailed consideration of the exact proportion of the total cost of a road represented by these features, I should say that in general the permanent features would average at least 50 per cent. of the total cost. So that, if the other 50 per cent. must be figured as perishable and subject to renewal, the debt should not cover a period longer than twice the length of this perishable portion.

4.—Road building and maintenance comprise work requiring special qualifications on the part of those who direct it.

If the laws would require that all persons selected to have immediate direction of road or bridge construction and maintenance possess practical knowledge and experience, and that this fitness be tested by some sort of competitive examination to be prescribed by a state highway department, acting either directly or through a civil service commission, the net result would undoubtedly be the saving of many millions of dollars of road revenue and a wonderfully increased efficiency in our road system.

5.—Responsibilities should be definite as to persons.

This proposition is aimed at the elimination of our present complex and cumbersome system of road management. If all of this antiquated organization could be swept aside and in its stead one or a few officials endowed with authority and charged with responsibility in each county, the beneficial effects could not fail to be most marked.

6.—Continuous employment is more conducive to efficient service than intermittent and temporary employment.

It is so self-evident that a minor defect in a road can be repaired at its inception with little effort, and that if allowed to go on it may require the entire reconstruction of the road surface, that it seems scarcely necessary to urge the soundness of this proposition.

7.—The specialists who direct road work should be appointed instead of elected, and they should hold office during efficiency instead of for a fixed term.

The seventh proposition is designed to attract to the work men who look upon road-building as a life profession or occupation. If the right man is in the right place, it is absurd to limit him to a fixed term, for his position is not a reward.

8.—No road is wholly permanent, but requires continuous upkeep, for which financial and supervisory provisions must be made.

A house is not permanent without repair, a railroad track is not permanent without repair, then why should public funds in a large amount be expended in road construction which, without adequate maintenance, may deteriorate to the extent of 50 per cent. in a few years?

9.—Cash is a much more satisfactory form of tax than is labor.

If you provide an efficient highway engineer or county superintendent with a modest amount of cash and let him select competent, efficient laborers, he can quadruple the effective results obtained by the same number of laborers under the old statute system.

10.—All agencies at the disposal of the state, capable of use in works of public improvement, should be so used, rather than in such commercial production as would conflict with private enterprises.

The tenth proposition is directed partially toward the convict labor question, and is based upon the assumption that offenders against society owe a debt to society which should be paid in such form as will most benefit society, and the further assumption that honest labor should not be discriminated against through the sale or disposal of products created by criminal labor. The practical application of this proposition would mean the employment of convicts in road-building, the preparation of road materials, or in other works of public improvement so far as practicable. This proposition is intended also to emphasize the necessity for correlation of the states' various agencies in the interest of road improvement. For example, a state geologist should be helpful in the selection and location of road materials, the laboratories of state universities should be useful in the testing of materials, the university staff should be helpful in the giving of theoretical instruction and in many cases in practical extension work, state bureaus of statistics and agriculture should be helpful in accumulating essential data for the road improvement work in the state, and state civil service commissions should be of very great use in the inauguration and conduct of the merit system in the filling of positions requiring technical or practical qualifications and experience.

The work of the Paving Commission of Baltimore, Md., since it began its operations on January 1, 1912, has included the improvement of about 85 miles of streets, 30 ft. in width between curbs, according to a recent statement. The majority of the paving laid by the commission has been sheet asphalt. During 1913 the commission laid about 553,000 sq. yds. of improved pavement, or approximately 31 miles. This work included the construction of about 323,000 sq. yds. of asphalt paving, 125,000 sq. yds. of vitrified brick paving, 71,000 sq. yds. of granite block paving, 13,500 sq. yds. of bituminous concrete paving, 10,000 sq. yds. of cement concrete paving, 8,500 sq. yds. of scoria block pavement and 2,000 sq. yds. of wood block pavement. Since the beginning of the Annex improvement work in 1906, the Commissioners for Opening Streets have laid over 64 miles of pavement. Of this total, 17 miles were laid in 1914. The work in the Annex last year also included the completion of 250,000 cu. yds. of grading.

A French process of "electro-curing" timber is stated to give perfect seasoning in a single night, and at little cost. With lead-plate electrodes on each side, the timber is placed in a solution containing 10 per cent. of borax, 5 per cent. of resin, and a little soda. Application of the current expels the sap and fills the wood cells with the borax and resin.

Brick Paving for Roads and Streets

By John Laylin*

OUR specifications for brick pavement improvements provide as follows: That in the preparation of the subgrade, all muck, quicksand, soft clay and spongy materials that will not consolidate under the steam roller shall be removed, that backfilling of all excavations shall be rammed in courses of not more than 6 inches of loosely-filled earth; that embankments shall be built up from the bottom in successive, even layers not exceeding 12 inches in thickness; that each of these layers shall be rolled until thoroughly compacted; that when the slope upon which material for embankment is to be placed exceeds two to one, such slope shall be furrowed before any material is placed thereon, and that areas on which embankments less than 1 ft. in depth are to be placed shall be broken up by plowing or other means.

After the surface of the subgrade has been properly shaped the roadbed shall be thoroughly rolled and compacted so that it does not wave or spring under the roller. Rolling shall be done with a self-propelled roller weighing not less than six tons.

That foundation for pavement may be made of either Portland cement concrete, old pavement compacted broken sandstone, limestone, slag, gravel or vitrified clay.

Great care is to be used in selecting aggregates for concrete, all materials being submitted to tests to insure quality meeting requirements as specified.

Aggregates are so proportioned as to produce concrete, substantially composed of 1 part cement, 2½ parts fine and 5 parts coarse aggregates, in which the mortar shall be not less than 110 per cent. of the volume of the voids in the coarse aggregates.

Coarse aggregates may consist of crushed boulders, crushed limestone, slag or gravel that will pass a screen having openings 1½ in. in diameter and be retained upon a screen having openings ¼ in. in diameter.

A cubic yard of concrete in place shall not contain less than five sacks of cement.

Concrete shall be mixed in a batch mixer, so-called, the drum of which shall not make less than 15 revolutions, at a speed of between 15 and 20 revolutions per minute.

Materials shall be mixed sufficiently wet to produce a concrete that will require no tamping. Subgrade must be moist before concrete is placed thereon.

The surface of concrete shall be shaped by the use of a suitable templet cut to conform to the crown of pavement, and shall be floated in such a manner as to thoroughly compact the concrete and produce a surface the exact crown specified. The finished surface of the concrete shall conform so nearly to that indicated on the plans that it will nowhere vary more than ½ in. from the previously described templet or a 10-ft. straight-edge applied to the surface of the concrete and parallel with the centre line of the pavement.

Care shall be taken to protect concrete from rapid drying out and freezing, and traffic is prohibited for ten days from time of laying.

A thoroughly consolidated old macadam or gravel road, if of sufficient depth, may be considered satisfactory pavement foundation. The old road shall be thoroughly cleaned, and if irregular, shall be scarified, graded to the proper elevation and all depressions filled with the same material of which the course consists. All foundation material placed must be thoroughly filled, water-bound and compacted.

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*Division Engineer, Ohio State Highway Department.

Rolled foundation shall consist of either gravel, broken sandstone, limestone, slag or vitrified clay. Sandstone fragments must not exceed 6 in. in greatest dimension, and all other materials must pass a screen having 4-in. circular openings and be reasonably well graded from 4 in. down to the smallest size found in the product.

Gravel shall not contain more than 15 per cent. of clay or loam.

Rolled foundation shall be constructed as a one-course water-bound macadam pavement and brought to the proper crown and grade within the limits specified for concrete foundation.

That curbing shall be either sandstone or concrete of dimensions indicated on plans and quality as specified.

That sand cushion shall not contain more than 8 per cent. by weight of clay or loam. Sand shall be spread over foundation, shaped with templet, rolled till compact, and made ready to receive the paving blocks.

That paving blocks shall be laid in an upright position upon the sand cushion in straight courses across the road, and shall be laid so that the longitudinal joints are broken approximately at the centre of each block and the long dimension of the block is perpendicular to the centre line of the road on the tangents and practically parallel with the radius of curves having a radius not greater than 150 ft.

All blocks to be laid with the lugs in the same direction and set as closely together as possible. In all cases the end joints shall be made close and tight, the joints to be at right angles to top and sides. The cutting and trimming of blocks shall be done by experienced men, and proper care shall be taken not to fracture or injure the part to be used.

After a sufficient number of blocks shall have been laid, the pavement shall be thoroughly dampened by sprinkling, and all soft, porous or unacceptable blocks will be marked by the inspector and shall be removed by the contractor. When any section shall have contained more than 10 per cent. of rejections, the blocks of the entire section shall be taken up and the cushion re-adjusted. As soon as possible after the block in the pavement is inspected, rejections removed and replaced with acceptable block, the surface shall be swept clean and then rolled with a self-propelled roller weighing not less than 6 tons. When rolling and ramming are completed, the surface of pavement shall conform so closely to that indicated on the plans, that it will nowhere depart more than ⅜ in. from properly formed templet or a 10-ft. straight-edge applied to its surface.

Soon after the pavement has been compacted and surfaced, the joints between the blocks and the curb shall be filled with a grout filler composed of one part Portland cement and one part sand. Detailed specifications set forth manner of applying grout.

Paving brick specifications provide:

That the brick shall be standard wire-cut-lug or repressed paving block of standard size. The standard size of brick shall be 3½ in. in width, 4 in. in depth and 8½ in. in length. The brick shall not vary from these dimensions more than ⅛ in. in width or depth. They must be thoroughly vitrified and annealed, regular in size and shape and uniformly burned. When broken, they shall show a dense, stone-like body, free from lime, air-pockets, cracks and marked laminations. No surface of any brick shall have kiln marks more than 3-16 in. in depth or crocks more than ⅝ in. in depth, and the wearing surface of the brick shall not have kiln marks more than 1-16 in. in depth and shall be free from cracks. The bricks shall have not less than four nor more than six lugs, all on one side of the brick, so that when the bricks are properly laid in place in the pavement, the joints between the brick will not be less than ⅛ nor more than ¼ in. in width. The name or trade mark of the manufacturer, if shown on such bricks, must be by a recessed design or by recessed letters and not by a raised design or raised letters.

If the edges of the brick are rounded, the radius shall not exceed ⅛ in. The brick must not be chipped in such a manner that neither wearing surface remains intact or that the lower or bearing surface is reduced in area by more than one-tenth, but such brick, if otherwise satisfactory, may be used in obtaining the necessary half brick for breaking courses and the necessary pieces of brick for closures; provided that the wearing surfaces of the part of brick used shall be intact. The brick shall not be glazed. To determine whether the material of the brick as a whole possesses to a sufficient degree, strength, toughness and hardness, samples of the brick shall be submitted to the rattler test. The test shall be made in accordance with the method and in a rattler as described in the recommendations by the Sub-committee on Paving Brick to the American Society for Testing Materials. Five samples of each kiln or shipment may be selected; one sample from what appears to be the softest brick and one sample from what appears to be the hardest brick, neither of which shall lose of their weight more than 24 per cent.; and three samples representing an average of the kiln or shipment which shall lose of their weight not more than 22 per cent.

The quality of the brick shall be of such uniformity that the range between the highest and lowest loss by abrasion shall not exceed 8 per cent. If the kiln or shipment of brick should fail to meet the above requirements—and it is fair to assume that it would meet them, if not more than 10 per cent. are culled—then the contractor may at his option re-grade the brick. When the re-grading is complete, the kiln or shipment shall be re-sampled and re-tested, as under the original conditions, and if it fails to meet any of the above requirements, it shall be finally and definitely rejected. Sampling may be done at the factory prior to shipment, and brick accepted as the result of such sampling will not be rejected as a whole but will be subject to such culling as may be necessary to meet all of the requirements except that of the rattler test.

In the preparation of our plans it is our endeavor to embody the use and requirements of the best possible foundation, and the best possible drainage consistent with the economy of the road.

Following this rule, a concrete foundation for brick pavements is generally provided, and as the greatest assurance against longitudinal cracking in the wearing surface, the advantage of a dry sub-base is considered essential. It is the general belief that brick pavement cracks are caused more by frost action than high temperature stresses. In fact, a sufficient and proper drainage of the subgrade of all roads, including the brick road, is regarded as of the utmost importance. Frost has little effect where moisture is almost entirely absent; hence these provisions carefully observed are certain to reduce to a minimum all deleterious climatic effects.

The Ohio State Highway Commissioner let contracts for brick roads in 1912, 1913 and 1914, mileage as is shown in the following table:

	1912	1913	1914
Mileage brick roads contracted	33.47	27.71	164.0
Per cent. brick road of total mileage of all roads	20.7	17.7	32.5
Contract price for brick roads	$507,899.19	$486,925.87	$3,415,584.45
Per cent. of total contract price of all hard-surfaced roads	36.4	35.3	46.3
Average contract price per mile for brick roads	$15,680.00	$17,572.00	$20,827.00
Average contract price for brick roads per foot in width per mile	$1,150.00	$1,379.00	$1,364.00

The contract price for brick roads included grading, draining, curbing, and paving for the years 1912 and 1913, but also included bridges and culverts for the year 1914.

In conclusion, it may be said that brick roads and streets should always have a solid subgrade, perfectly drained; that a concrete foundation should be provided wherever traffic conditions are heavy, and that the surface of concrete foundation should be made true and smooth and exactly parallel with the crown of the street; that the sand cushion should be thoroughly compact and from 1½ to 2 in. in thickness; that a cement grout filler is the best filler; and that a brick road is a dependable road.

The paramount interest in brick roads that more greatly concerns the tax-paying public is the same that is involved in the expenditure for any road, no matter what the type, and that is the efficient building of the road itself in compliance with the plans and specifications. The proper construction of a brick road is no more difficult than the construction of any other kind of road, but every requirement of the plans and specifications should be carried out. Plans, specifications and contract pre-suppose that each and every requirement therein is a part and parcel of a necessary adjunct to the value of the road intended to be built. A complete co-operation of the combined influences of public sentiment, official authority and the obligation to the contractor is necessary to reach the ideal in road building. Without the combined forces of all, the most conscientious official, the most diligent contractor or an anxious public acting singly and alone cannot attain the best results.

European Rock Asphalts

By J. W. Howard, of Columbia University, New York City

SUBSEQUENT to the success of the European rock asphalt or bituminous-limestone pavements, many substitutes, made of artificial compounds, have been used. Success has followed the use of certain compounds of graded sand or graded crushed stone, limestone, or equivalent powdered mineral in small quantities filling voids, and the whole mineral aggregate bound together with asphalt cement. This second general method of constructing asphalt and bituminous pavements was developed in America and predominates here. I will confine your attention to a sub-group composed of natural bituminous limestone, which is one of the general group of rock asphalts, which group also contains natural bituminous sandstone, of relatively little value.

Definition

It is best to clearly define the sub-group of bituminous or asphaltic materials to which I call your attention. The deposits of rock asphalt, of Europe are natural, bituminous limestone which have been used for more than two hundred years; at first for various coatings and extracting bitumen, and then, beginning about one hundred years ago, for pavements and other purposes. This mineral is composed of fine-grained limestone, thoroughly impregnated and saturated with an adhesive, durable bitumen. The bituminous limestone deposits or quarries of Europe, and the few known ones in America and other countries, vary in purity and quality, some of the deposits containing some qualities of sand, clay, etc., in some parts, if not throughout each deposit. The proportion of bitumen or asphaltum present in the rock varies in all deposits from portions not saturated at all, to portions carrying the desired per cent. of this cementing substance and upwards to a large excess of bitumen in the rock, which makes it impossible to use such rock asphalt unless it is thoroughly blended with other similar, suitable rock asphalt containing very little asphaltum or bitumen, so that a uniform result contains the per cent. of bitumen required.

The success of compressed rock-asphalt pavement in Paris in 1854 and ever since has attracted the attention of all important cities. London, England, began its use by paving Threadneedle Street, in 1869, and has steadily extended its use to many other streets of that city. Geneva and Berlin began in 1871, and all the principal cities of Europe soon followed. It began to be used in America, and in 1876 a portion of Pennsylvania Avenue, Washington, D.C., was paved with it. Its extensive use in America is prevented, first, because of the invention by DeSmedt, of the American form of sheet asphalt pavement, when he laid his first piece on William Street, Newark, N.J., in 1871, then in other cities, and in 1876 on a portion of Pennsylvania Avenue, Washington, D.C., where his artificial composition of sand, limestone powder, and asphalt cement proved successful. This American substitute and rivalry rapidly spread to all important cities and many smaller ones of America, and has been used to a limited extent in other countries.

The rock asphalt pavement of Europe must be transported in its entirety from the quarries to the city where used. Freight, therefore, is a large factor in its cost and confines its use within certain freight radii of the various deposits where the asphaltic limestone is found. On the other hand, the American system uses sand, found generally near the cities, and requires transportation of the asphalt cement only, which composes about ten per cent. of the weight of the pavement. The rock asphalt deposits of America are so isolated from large cities that there is relatively little demand for compressed, asphalt-limestone pavements, although a few have been laid with American asphaltic limestone in a few cities in or near Utah and Texas, where there are some rock asphalts, similar but not exactly like those of Europe.

Sources of Supply and Composition

The following tables will enable you to grasp quickly the classification of various bitumens and the relative positions of rock asphalts, both bituminous limestone and bituminous sandstone. Kindly remember it is bituminous limestone we are considering.

The countries where asphalt limestone is found are shown in the first part of Table II. The principal sources of supply during the past two hundred years are at various deposits or quarries located in France, Italy, Sicily, Germany, Switzerland, and Russia, within a long belt of limestone, at points where the limestone is impregnated or saturated with asphaltum. In a general paper of the kind I am presenting, it is not necessary to enumerate all of the many large and small quarries of rock asphalt which have been opened and are in use in Europe and the few elsewhere. Table III. gives the location of typical, operated deposits in Germany, France, Italy, Sicily, Switzerland, Spain, Russia, and of two of the three in Oklahoma, Utah and Texas. Table III. also gives chemical analyses of samples from each of them. It must be remembered, however, that the per cent. of asphaltum or bitumen in the asphalt rock in each deposit varies somewhat from the samples analyzed, according to the portion of the quarry from which the sample is taken. There are other deposits in the countries named, but those enumerated are sufficient to illustrate the principles before us.

Methods of Quarrying. Preparation and Shipping

The methods of obtaining the crude material are the usual ones, with certain variations, used in quarrying any limestone. At some of the deposits where warm weather makes it difficult to drill or bore holes for blasting or breaking out the rock asphalt, due to the adhesiveness and gummy nature of this rock when warm, the mining or quarrying is carried on in drifts or tunnels underground. In such places quarrying in cold weather is in the open.

The rock is shipped either in broken lumps or in ground, powdered form, according to the distance to be shipped, or as ordered. The customs duty from one country to another varies whether the rock is in lumps or labor has been paid to powder it. Previous to use for almost all purposes to which rock asphalt is applied, it is crushed, generally in special-toothed rolls, although in cold weather jaw-crushers can be used. It is then reduced to powdered form by centrifugal pulverizing machines or sometimes by special flail or beating machines.

If used for compressed sheet asphalt pavements, rock must be selected having a uniform and requisite per cent. of bitumen in it suitable for the climate, traffic, and slightly different rock from different quarries. It is customary to blend the rock when necessary from parts of a quarry or from different quarries to get desired results. For paving streets, the powdered rock, in its natural state, is warmed at the place where it is to be used for asphalt pavement for vehicle and other heavy traffic, or for other uses where this compressed, solid form of rock asphalt is required. The warmed material is spread upon a suitable foundation and compressed by ramming with hot, heavy, iron rammers, which condense the material to the necessary density and solidity. The surface of the pavement is smoothed with hot smoothing-irons, which must not be so hot as to burn the bitumen in it. A heated, heavy, hand-roller is also used to smooth out any indentations left by the rammers. Subsequent to its first construction, such rock asphalt pavements are further

TABLE I. CHARACTER AND LOCATION OF NATURAL BITUMENS AND COMPOUNDS

	Bitumen	Character	Where Found
Important Bitumens and Compounds.	Natural gas.	Gaseous.	North America, South America, Europe, Asia.
	Natural naphtha.	Thin fluid.	North America, South America, Europe.
	Petroleum.	Thick, oily.	North America, South America, Europe, Asia.
	Maltha & compounds.	Soft at 77°F., called also "Soft Asphalt."	N. Amer., S. Amer., Europe, Asia, Africa, Australia.
	Asphaltum & compounds.	Stiff at 77°F., "Hard Mineral Pitch."	N. Amer., S. Amer., Europe, Asia, Africa.
	Glance pitch.	Brittle at 77°F., "Mineral Pitch."	North America, S. America, Asia, Africa.
	Elaterite.	Elastic, "Mineral Rubber."	North America, South America, Europe, Asia.
	Ozocerite.	"Mineral Wax."	North America, Europe, Asia.

TABLE II. ROCK ASPHALT

Compounded with Limestone. (Containing Silicates, etc.) Found in Austria, Cuba, France, Germany, Hungary, Italy, Russia, Sicily, Spain, Switzerland, Turkey and United States.	Compounded with Sandstone. (Containing Carbonate of Lime, etc.) Found in France, Germany, Italy, Russia, Sicily, Spain, Turkey, United States, Alaska and Canada.

Table III. ANALYSES OF BITUMINOUS LIMESTONES (ROCK ASPHALT).

	Germany			France		Italy		Sicily	Switzerland	Spain	United States		Russia
	Limmer	Lobsan	Vor Wohle	Seyssel	Mons	St. Valentino	Cesi	Ragusa	Val de Travers	Maestu	Utah	Texas	Sysran
Asphaltum	14.30	12.32	8,50	8.15	10.20	8.83	7.15	8.92	10.15	8.80	36.28	11.65	30.50
Carbonate of Lime	67.00	71.43	80.04	91.30	84.63	80.00	73.76	88.21	88.40	9.15	29.52	.03	66.23
Sand	....	3,15	...	....	....	....	14.24	.60	....	68.75	6.46	88.32	...
Aluminum and Iron	...	5.91	....	.15	....	....	....	.91	.25	4.35	27.44	....	...
Sulphur	....	5.18	4.03	...	...	....	3.02	....	....	....	....	....	....
Magnesium-Carbonate	17.52	.31	.55	.10	....	....	....	.96	.30	8.10	...	...	3.27
Insoluble in Acid (h.cl.)	....	....	4.77	.10	....	....	.10	....	.45	....	....	....	...
Undetermined	1.18	1.70	2.11	.20	5.17	11.17	1.73	.40	.45	.85	.30	....	....
Total	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.

NOTE—The materials vary somewhat from each deposit.

compressed a little by traffic. The result is a dense, durable, waterproof, monolithic pavement, which, with reasonable maintenance, can be kept in constant good order indefinitely.

If the rock asphalt is to be used for making asphalt-mastic, then it is heated for several hours in revolving, large, mixing cylinders, into which is introduced some pure or relatively pure asphaltum or asphalt cement, from other sources. The result is that the natural bituminous limestone has its bitumen enriched until the per cent. in the asphalt-mastic is raised to the amount desired, generally about 20 per cent. This mastic, while hot, is run into forms or molds, so that the mastic is shipped all over the world in cakes of different forms and with different brands, according to the source of the supply or manufacturer.

The asphalt-mastic, on arrival at the place to be used, is melted in special kettles, at the same time mixing with it some more asphaltum or asphalt cement, and adding suitable sand and sometimes very fine gravel, according to the purposes or uses intended.

Uses

The two principal uses of natural asphaltic limestone, called also bituminous limestone and rock asphalt, are for constructing the wearing surface layers of sheet asphalt pavements for streets and equivalent requirements; also for manufacturing rock asphalt-mastic for use in various compounds for sidewalks, floors, roofs, decks, waterproof linings, damp course, pavement of bridges, etc. It is used all over the world in breweries, sheep, pig and cattle pens, cellars, coach-houses, conservatories, grain houses, courtyards, fish markets, warehouses, gunpowder magazines, laundries, lavatories, malt houses, markets, railway platforms, freight houses, playgrounds, slaughter houses, stables, wash houses, etc. It meets conditions where surfaces are needed which will not crack or deform from expansion and contraction of heat and cold or from slight settlements and deformation of floors, foundations, and structures, which surfaces at the same time resist moisture and the wear of foot and other light traffic.

It is not the province of this paper to go into the many and minute details of technical preparation and methods of use for each of the many applications of rock asphalt. The industry is large and its sub-divisions too many to be presented otherwise than in the several available publications on the subject, the authors of which I have named.

The most successful use of bituminous limestone depends principally upon the selection of a good quality of natural rock and practical experience in handling it. Experienced foreman and trained laborers in this industry are available almost everywhere.

At Toronto, good progress is being made on the new Registry Office which is being erected on Elizabeth Street at a cost of $400,000. The architect is Mr. C. S. Cobb, and the masonry contractors are Messrs. J. A. Wickett, Limited. The new building is to contain two storeys and basement. It will be 135 ft. by 165 ft. in dimensions, and will be of stone, steel and fireproof construction.

The Standard Paving Company, Limited, capitalized at $200,000, has been incorporated at Ottawa, Ont. The incorporators are J. Foley, J. Gleeson, E. P. Gleeson, P. C. Cooper and F. M. Doherty.

The Toronto-Hamilton Roadway Commission Bill has been finally passed by the Special Commission appointed by the Legislature.

The Inspection of Asphalt Paving

Specially contributed by T. Linsey Crossley
Chemical Engineer, Montreal

THE trouble with much asphalt inspection is that it is begun too late and is often controlled by the wrong parties. There are two reasons for these conditions: first, in most cases the specifications make the Engineer the only referee; second, attention is focussed on the "wearing surface" to the neglect of the binder course.

Discussing the first source of trouble, it is distinctly to be understood that this is in no way the fault of the engineer. He would be very glad, as a rule, to divide the responsibility. Very few town engineers, especially those in the smaller cities and towns, have had any broad experience in the laying and inspection of asphalt. When such towns decide to take up the question of sheet asphalt or other bituminous paving, the question of specifications comes up at once.

In many cases, the specifications of some other city are copied without any changes. In other cases, parts only are copied; other parts that seem to the engineer like unnecessary detail are left out or abridged. The usual result of this is a weak spot which makes it difficult to control the contractor. It becomes a case of two heads being better than one. The engineer's experience and that of a good chemical engineer with a knowledge of asphalt inspection and testing should be applied jointly to the study and preparation of a set of specifications covering the case in point, having in view the local conditions as to soils and the traffic character on the roadways to be paved. Pavements having little or no traffic call for special mixtures as well as those having heavy traffic. Many towns have no sand within reasonable distance that would comply with ideal requirements, so that the best grading possible with the sand that can be used must be provided for in the specifications.

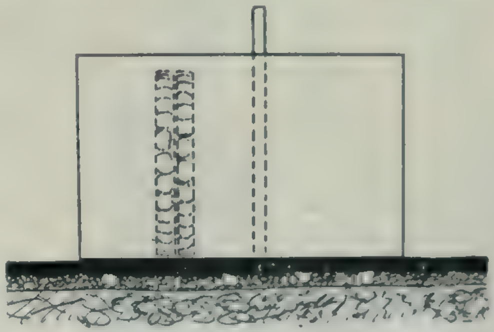


Diagram showing effect of oversize in binder course.

It sometimes happens that an engineer has had experience with paving which has been made with a certain brand of bitumen, or one from a certain source which has been satisfactory. It is quite natural that the records should form the basis of any specification he might draw up. In such a case it may be found that a very good maker is barred from tendering. In New York City the Borough of Manhattan precludes that possibility in its 1914 specifications by using the clause "Any asphalt proposed to be used or furnished under this contract shall be equal in quality and composition to the recognized standard for its particular kind or type." Until quite recently the New York specifications called for Bermudez asphalt. Now the specifications are open.

The other difficulty in asphalt inspection is to ensure adequate attention to the binder course, which

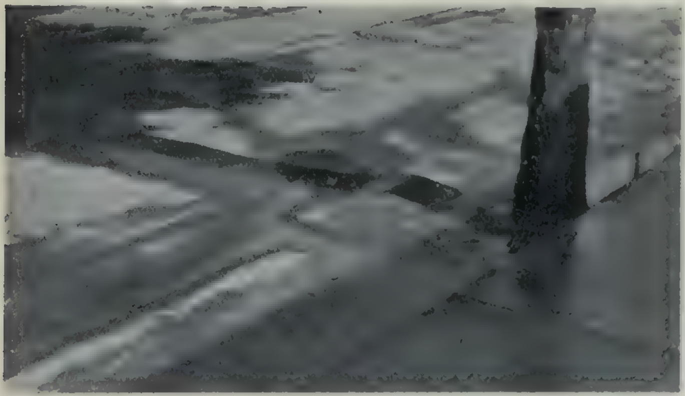


Fig. 2.

is the portion between the wearing surface and the concrete foundation. This course is of two distinct types—"open" and "closed." The former is composed of crushed stone only, while the latter has voids partially filled with coarse sand. The "open" type is more often used as it is easier to lay, takes less bitumen, is popularly supposed to present a better surface for the adherence of the wearing surface, and allows of more delay before laying the surface mixture. The preference of the writer is for the "closed" type, as, if properly laid, it will give a better surface. The open type will give a good even surface if properly raked out and rolled smooth at the proper temperature and with the right amount of asphaltic cement. The asphaltic cement for the binder should be a little softer than that used for the surface.

The maximum size of stone allowed for binder course should be half an inch less than the total specified depth of binder, so as to avoid the possibility of oversize producing the condition shown in the diagram.

Fig. 1 is a section through a sheet asphalt pavement showing concrete base, binder course and surface. The full line rectangle indicates the roller used on binder and also in finishing the surface. The white irregular parts of the binder course show oversize of greater dimensions than the specified depth of binder. The dotted lines indicate cart and motor truck tires. The broad tread of the roller spans several large pieces of stone and consequently the binder course is not thoroughly compacted at these points. When the surface is raked on and rolled, there is still a lack of compression at these points. This is not visible until some time after the street is open for traffic, when depressions are sure to be formed, and an uneven surface is the result. Very few people realize the great weight imposed on a very small area by a loaded motor truck. Where heavy traffic is expected, extra care must be taken in specifying, laying and rolling.

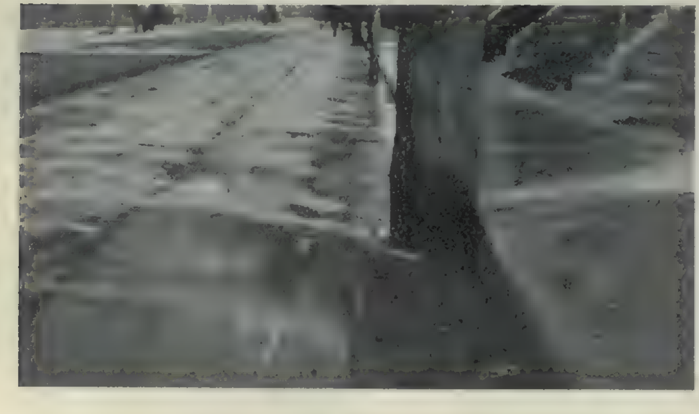


Fig. 3.

Figs. 2 and 3 show the effects produced on surfaces by one-way traffic over a pavement whose binder course was deficient in bitumen and whose surface mixture contained an asphaltic cement that was much too soft. Properly prepared specifications or competent inspection would have prevented this trouble.

Much could be written on every phase of paving inspection, but the object of this article is to lay stress on the need for special consideration of local conditions in preparing specifications, and on the likelihood of trouble arising from neglect of close inspection of the binder course. An experienced and independent inspector would be able to supervise paving even without any specification, or with only a very broad one, and by conference with both parties might enable the municipality to secure good pavements at less cost both to itself and to the contractors.

The Wood Block Pavements of London Town

By J. Brooks

EVERYONE knows the extent of London's wood paving. Not even the scarcity of wood due to the War has made this type of construction any less popular in the world's metropolis. As I write this article the Westminster City Council is closing a contract for twenty thousand wood paving blocks.

The improved Wood Pavement Company of London gets most of the council work. More than eight million square yards of creosoted wood blocks have been laid in the city of London and the city of Westminster by this company alone. In one year the company laid more than 375,000 square yards of wood blocks. Over a period of four years the company laid 100,000 superficial yards of wood blocks on London County Council tram tracks alone. A length of roadway measuring over three hundred and fifty miles has been paved with creosoted wood blocks by this company, the contracts including some of the most important cities of Europe. Four hundred streets in London and its suburbs have been wood paved by this concern.

And now to see on what principle is based this preference for wood. Among reasons advanced here are the following:

1. That creosoted wood pavement wears smooth and even for a longer period than other pavements, and since the surface is the main thing to be considered this means that it really lasts longer than other pavements.

2. That in all kinds of weather it is less slippery than asphalt or granite sett paving.

3. That it offers a good foothold and does not jar the feet and legs of horses.

4. That it is preferred by motorists to any other roadway, and is worn away least of all by motor traffic.

5. That it is a silent paving.

6. That by reason of the antiseptic qualities of the creosote oil, it is a highly sanitary pavement—a great asset.

7. That in consequence of the blocks being thoroughly impregnated with creosote the amount of expansion and contraction is almost nil.

8. That by the creosoting process the timber is rendered untenable to animal and vegetable life, the

albumen is coagulated and the pores are filled with creosote so that no germs, air or moisture can enter the wood.

9. That taking into consideration first cost, maintenance and cleansing, it is, under most circumstances, a more economical form of paving than macadam or asphalt.

The following are a few extracts taken from the published reports of this international road gathering:

"Experience in Paris, London and other large cities shows that a surfacing of wood paving, if carefully laid and properly cleaned, wears evenly and slowly and is ideal. With careful bedding and joining it is practically waterproof. Wood block paving from three to five inches thick, is an ideal surfacing for bridges. Where gradients permit wood block pavements are very suitable where the traffic is great."

This is what the city and borough engineers of Leicester, Nottingham, St. Pancras and Hampstead say regarding wood paving: "Most suitable woods are pine and fir; blocks should be close grained with not more than ten per cent. of bright sap; no blue sap or discolored blocks to be used. There is a distinct advantage in using creosoted wood blocks, as their use distinctly reduces expansion and contraction. Wood makes an excellent paving for streets in cities. The estimated cost of repair per annum in streets where the traffic is heavy is from 18 to 25 cents per square yard."

The chief engineer of Vienna, a member of the road congress, estimates the life of lumber paved streets in Austria at ten years. He said: "Experience gained in Vienna with soft wood blocks may be considered satisfactory. The more so when it is remembered the horses in Vienna are shod with exceptionally sharp studs or prongs which tends to increase considerably the wear of the blocks."

In Petrograd the congress found that the block layers cut the blocks the desired size as they laid them. This method was not considered satisfactory nor conducive to good results.

Regarding the life of lumber paved city streets, figures selected from some of the best known and heavily traversed thoroughfares of London where lumber has been used for paving give a very clear idea of the value of this material, showing a life on the average of fifteen years.

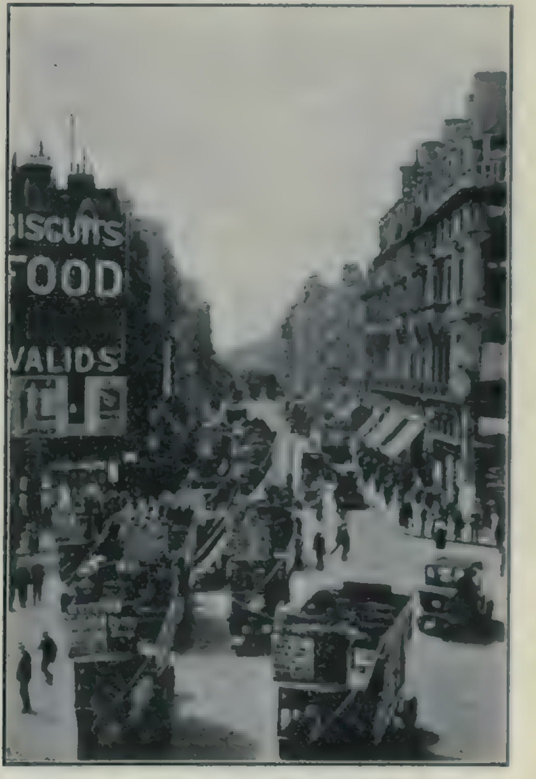
Athough wood paving has been known in London since 1872 it is only in the last few years that it has become the leading paving medium here, it **having** superseded every other kind of paving material for city and suburban districts. John Bethell invented the creosoting process for wood blocks which was originally intended expressly for noiseless paving. Now, however, that it has been proved the most economical and useful form of street paving, one finds it in Liverpool, Birmingham, Leeds, Chesterfield and such world-renowned thoroughfares as Bond Street. Fleet Street, Ludgate Hill, Regent Street, London.

This article would hardly be complete without mention of the attitude towards lumber of the Metropolitan Committee on Materials and Means of Paving London Streets. Recent reports made by this committee on London streets and the effect of motor traffic over same include the following extracts: "The general feeling of the great majority of the committee is that soft wood is more desirable and useful than hard, and that wood is preferable to asphalt or granite sett in hard worked roads.

"It would appear that the principal kind of paving laid down during the year under review in main roads was creosoted soft wood."

The Wood Block Pavements of London Town

Stretches of roadway which are the delight of motorists. These thoroughfares —Leicester Square on the left, and Fleet Street on the right—are a fair criterion of the wood-paved surface of the world's metropolis.



Reports of Authorities

Regarding motor traffic effect on wood-paved streets the committee said: "As regards maintenance on wood-paved roads the surveyor thinks that time will prove decreased cost, inasmuch as the life of the wood will be slightly lengthened, but on all other roads, he considers the expense is largely increased. It does not appear that the cost of maintaining wood-paved roads has been increased in consequence of their being traversed by motor vehicles." Commenting on the use of lumber in specified London districts, the committee reported:

Fulham.—Deal excellent.

Harwood Road.—Creosoted deal lasted 16 years one month. Traffic considerable. Wear excellent.

Hammersmith.—Creosoted wood in five streets with considerable traffic. Wearing well.

Fulham Palace Road.—Creosoted wood, traffic considerable. Wear excellent.

Hampstead.—Surveyor's opinion on deal paving: "Excellent."

Holborn.—In Chancery Lane, where the traffic is, of course, considerable, creosoted Swedish deal blocks 3 x 9 x 5 inches have been laid.

Westminster.—In the opinion of the city engineer the increase of motor traffic prejudicially affects macadam roads, and perhaps, to some slight extent, asphalt roads also; but he does not think that, as a result of motor traffic in Westminster there has been any increase in cost of maintaining wood-paved roads, originally laid on present approved methods.

Wandsworth.—Creosoted deal lasted 17 years. Traffic considerable. Wear exceptionally good considering the amount of traffic.

Stoke Newington.—Creosoted deal lasted about eighteen years. Traffic considerable. Wear exceptionally good. Soft wood wears infinitely better than hard wood.

Kensington.—In Notting Hill Gate the wood paving has been down twelve years. In residential thoroughfares the paving replaced wood paving laid from 16 to 20 years ago.

The use of creosoted wood blocks for stiff gradients have given unbounded satisfaction in London. The following figures compiled on gradients of London streets where the lumber paving is used may be of interest:

Arundel Street, Strand, 1 in 17; Haymarket, 1 in 33; Lower Regent Street, 1 in 28; Ludgate Hill, 1 in 25 to 29; Norfolk Street, Strand, 1 in 20.2; Savoy Street, Strand, 1 in 11.5; Surery Street, Strand, 1 in 14.4.

The wood paving concerns here keep enormous quantities of paving lumber in stock and operate big creosoting plants, block cutting mills, wood block flooring machinery and drying chambers. These companies contract to build lumber roads and maintain the roadways for periods of fifteen, seventeen, or twenty years at fixed annual payments, including first cost. They will supply any kind of wood and lay it to engineer's specifications. If, however, a long term of maintenance is required the companies prefer to carry out the work with such materials and by such methods that they have found by experience, to be the most suited to the purpose desired.

Care in Sewer Construction

SEWERS are, we believe, the least expensive public utility to be found in our city streets, comments The Municipal Journal in urging a plea for more care in their construction. The cost of the minimum size water main (4-inch) laid in place, continues our contemporary, is not less than that of the minimum size sewer (8-inch) laid at ordinary depth; and in addition we have, in the water system, reservoirs, pumping plants, etc. Street paving costs more per lineal foot of street than either, even with the narrowest roadway and cheapest class of wearing surface. And yet the last is probably the least essential to a civilized community.

Are not many of our sewers too cheap? Is it not too often the case that the cost of labor put into them is more or less regulated by the cheapness of the material used rather than the importance of the result to be obtained?

A sewer should be laid in straight lines or regular curves, and its grade should be as nearly true as it is possible to make it. Take a grade of one foot in one thousand (by no means unusual for 24-inch pipe and larger) and pipes 30 inches long. Then the fall in each pipe is three one-hundredths (or about one thirty-second) of an inch. Not only should care be taken that each pipe be set with less than this error in grade, but it should keep that exact position both during the remainder of the construction and afterward. Any departure from it will cause a damming of sewage above a high joint or a possibility of deposits at a low one, should the sewer at any time flow with very little depth; and with deep flow the irregularities will cause vertical eddies which will retard the velocity of flow and possibly cause deposits thereby. And deposits in sewers are the one thing above all others (except inadequate capacity) to be avoided. A sewer in which there are no deposits gives off no odors which can reach either street or connected building, and the sewage reaches the outlet or disposal plant in a fresh condition. But gases given off by putrefying deposits in sewers are a source of nuisances which some cities are spending thousands of dollars to palliate, and which may effect a disintegration of mortar in pipe or brick joints, or the concrete in a sewer shell.

Even more serious may be the results of settlement after construction, for these not only produce irregular grade, but probably open up joints and allow the sewage to pollute the soil, or ground water to enter the sewer (perhaps bringing sand or other soil with it) and increase the volume to be carried and perhaps pumped or treated. Leaking joints, although serious defects, are so common as to be the rule rather than the exception. And yet such joints cost many thousands of dollars yearly in increased pumping, larger purification plants, and larger sewers for carrying the "allowance for infiltration"; with probably increased deposits of inborne dirt to be removed—and deposits mean putrefaction.

No one will claim that tight joints are impossible, we believe; only that they are expensive, relative to the cost of the sewer. Nor will any deny that it is possible to construct a sewer that will not settle, no matter what the soil. But sewer construction has so long been looked upon as cheap construction that too many fight shy of anything that increases its cost. To them, bearing piles in bad bottom or a concrete cradle in soft earth, or the latter and a concrete collar at each joint to exclude ground water, are expenditures not to be considered for sewers, although for any other structures they would be deemed most necessary precautions.

The fact that a sewer is out of sight and seldom inspected even by those in charge of it; that reaching it for repairs is a very expensive and annoying matter, and that the materials and labor employed on it are relatively inexpensive, are all reasons for giving it the most careful attention to secure the best results rather than practically leaving the entire matter in the hands of an unappreciative foreman.

Before the work was commenced.

Laying base course.

The Use of Reinforced Concrete in Paving Lanes at Westmount

THE City of Westmount, P.Q., decided recently to improve the paving of the lanes by using reinforced concrete on a section of the city. This was in the nature of an experiment, the objects being to obtain lanes which would be cleaner, more sanitary, and easier to repair. The result to date has been entirely satisfactory. The paving was constructed under the direction of Mr. P. E. Jarman, city engineer, in the following manner:

A concrete curb 4 ins. wide and 4 ins. high above the finished road surface extends along both sides of the lane. The height of 4 ins. is reduced to the level of the roadway at the entrances to the adjoining property. These curbs are provided with expansion and contraction joints of Elastite every 25 feet.

The sub-grade of the roadway was graded to conform to the surface of the finished roadway, which is concave. This was rolled where possible, great care being taken to keep the sub-grade smooth and even. The sub-grade was wetted immediately before laying the concrete and all the wheeling was done on planks.

The sub-grade is drained by a 3-in. farm tile with tar paper wrapped joints laid in the bottom of a trench 1 foot wide and 1 foot deep, the trench being filled with broken stone. This drain extends along the centre of the lane with laterals about every 50 feet leading from the curb.

The concrete roadway itself is built in two courses reinforced with triangle mesh wire placed 2 inches from the surface and having the stranded longitudinal wires placed crosswise of the roadway. Gullies placed at convenient points along the centre of the lane receive the surface water and also the sub-grade farm tile drainage. These gullies are connected with the main sewers in the street.

The bottom course is 4 ins. thick 1:2½:5, the stone being 2-in. limestone. On this was laid No. 7 triangle mesh wire. The top course is 2 ins. thick of 1:1:1, the stone being ½-in. granite. The surface has a broomed finish. Provision for expansion and contraction was made by placing strips of Elastite along each curb and a transverse joint every 25 feet, the edges of the transverse joint being protected with Kahn steel protection plates. Directly the concrete had set sufficiently, it was covered with a layer of earth and kept wet for at least one week, after which the earth was removed and the concrete watered occasionally and allowed to dry out slowly. The lanes were opened to traffic two weeks after the earth was removed.

Grade separation in Ward Six, Toronto, a project which has been reported upon by the Works Commissioner, Mr. R. C. Harris, is estimated to cost over two million dollars. The construction would involve thirteen subways and five bridges.

Floating top course.

The finished lane.

Concrete Roads—The Cost of Their Construction and Maintenance*

By H. J. Kuelling†

Mr. H. J. Kuelling.

THE question "What is the cost per square yard or per mile of concrete road?" is as easily answered as "What is the cost of a house?" One is as definite as the other, for there are almost as many kinds of concrete roads as there are styles of houses, and for each kind there is a different answer.

Even after the quality and thickness of concrete to be built has been determined, there are naturally many local conditions that will have a marked bearing on the results—such as the lengths and kinds of roads available to haul material over; the facilities for unloading and hauling aggregates and cement; the amount of labor available; the necessity for camps; the distance and elevation that water must be carried, and also its source; the availability of suitable aggregates, and whether they must be washed, or crushed, or shipped by rail; and the weather conditions that are likely to exist. Any or several of these conditions may have a marked effect on the cost of construction. Given answers to these questions or conditions, the problem of figuring the cost becomes much simplified.

Assuming the standard Wisconsin State Specifications, which call for a 1:2:3½ mix, and assuming a pavement with an average thickness of seven inches, I will attempt to show you how we arrive at our estimates of costs. Some of the statements may seem like the A. B. C. of engineering, but will perhaps be of assistance to laymen.

With an average thickness of seven inches, we allow only five square yards per cubic yard of concrete, allowing the extra inch as a factor of safety. With a 1:2:3½ mix we know we need approximately one-half cubic yard of sand and about 0.84 cubic yards of aggregate, or a total of about one and one-third cubic yards of material for a cubic yard of concrete. No suitable material is available without shipping it in by rail, and we find that washed sand and gravel can be laid down at almost any siding in the county for $1.00 per cubic yard of sand or gravel, the sand to weigh three thousand pounds per cubic yard, and the aggregate a little less, depending upon the idea of the dealer. This brings our sand and gravel for a cubic yard of concrete to about $1.33, or about 27c. per square yard of road.

The next problem encountered is the unloading of this material on to the hauling vehicles. In our case nearly all the work has been done by hand. Allowing for lost time due to rain, switching of cars and waiting for teams, and figuring labor at from $2.25 to $2.50 per day of ten hours, we have a cost of five cents per square yard for unloading. This may be reduced a little, but we have found it safer to not expect too much from shovellers, especially in hot weather.

The next item is the most variable of any, perhaps, in the entire cost—that of hauling. The length of haul, the method of hauling and the kind of roads to haul over all have a marked bearing on the result; here also possible weather conditions must be taken into account, for after a rain the size of load and number of trips must be materially reduced. Where steep grades are encountered extra teams must be figured upon. Assuming an average haul of two and one-half miles, a team would average about three and one-half trips per day under our conditions, or about seventeen miles per ten-hour day, during the various kinds of weather. At six dollars a day, which we often are forced to pay, and assuming an average of one and three-quarters cubic yards per load, we arrive at a cost of $1.35 per cubic yard of concrete, or 27c. per square yard of road. The mixing and placing—under which we include all labor connected with the job, such as watchmen, pumpmen, smoothing grade, etc.—with our labor conditions, and allowing for lost time and overhead expenses, will come to about $1.00 per cubic yard or twenty cents per square yard. In case steel joints are placed, these will come to about two and one-half cents for the steel and one-half cent for the felt, when placed fifty feet apart, and one-quarter inch in thickness of felt.

The cost of furnishing water is rather uncertain, for the amount of pipe necessary may vary from one to three or even more miles per job. Assuming two miles of pipe at a rental of two cents per foot for use in placing a road one mile long, we have a water cost of about two cents per square yard. For carrying liability insurance a contractor must add about one and one-half cents in our State. The depreciation on machinery we have found to be about one and one-quarter cents per square yard. Trimming up the shoulders will require an additional expenditure of about one cent. The items as enumerated bring us to a total of 87¾ cents, to which we add a reasonable profit when figuring what a contractor should bid. Since we furnish cement in all cases, we add our cement cost only after the profit percentage has been included. With cement at $1.14 per bbl. on cars, and twenty cents per bbl. for cartage, we arrive at a cost of about $2.25 per cubic yard of concrete for cement, or forty-five cents per square yard. This gives us a total of $1.32 without a contractor's profit, under the conditions we met in 1913. Work done in 1913 by force account varied from $1.30 to $1.61, and that done by contract varied from $1.24 to $1.72, the variations depending entirely upon the local conditions. In 1914, with cement slightly higher but with labor and teams considerably cheaper, but other conditions about as in 1913, the costs in Milwaukee County caried from $1.10 to $1.45.

An engineer should thus be able to compute the cost of the various items in his community and separate the labor and material into fairly definite percents for each job. He will find that cement will vary the least, while hauling labor will vary the most.

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* Paper presented at the Eleventh Annual Convention of the American Concrete Institute.

† Of Milwaukee, Wis.—County Highway Commissioner.

In conclusion on the question of cost of construction, I want to repeat that it is merely a guess unless all the local conditions are considered.

Maintenance

The question of maintenance is one that will vary with the quality of concrete in the road. In other words, concrete that is of uniform texture will wear in a manner similar to sandstone blocks, and therefore demand very little maintenance, whether the aggregate be of hard or fairly soft material; the harder and tougher the sand and stone, the longer the life of the pavement. Where the mortar and the aggregate are allowed to become separated when the concrete is being placed there is certain to be an uneven wearing of the surface, which naturally becomes more and more pronounced as the traffic pounds, in falling into or climbing out of the depression.

It would seem, therefore, that the first maintenance required in a concrete road is to get as uniform and tough an aggregate as possible, and then to be sure that the concrete is properly mixed and placed. In case small depressions do occur, the time to look after them is as soon as they appear. We believe the best method to be about as follows: The surface should be first swept with a steel broom to loosen any dirt; after this the spot would be thoroughly swept with fibre street brooms; to remove the fine dust which the steel brooms leave behind we use ordinary house brooms, which leave the surface in a fairly clean condition. The depression is then covered with hot Tarvia X and covered with coarse sand or screenings and opened to traffic. In case the depression is of considerable depth, or what might be called a hole, I would advise one of two methods. First (in case you want to avoid delaying traffic) clean the depression as already described, and then paint it with a tar, upon which bring the whole to grade with crushed stone, being careful not to have stone as large in size as the depth of the depression. Tamp the stone in place with hand tampers, or roll with a roller, if one is available, and fill the voids with a heavy bituminous road binder, allowing about one gallon per square yard per inch in depth. The second method is to cut the poor place out entirely, and after trimming the hole and thoroughly sprinkling the sides fill with the same mixture as was used in the original road. After pouring the concrete, treat in the same manner as in reconstruction. Small defects due to balls of clay, sticks or coal getting into the aggregate may be best repaired the same way as described for shallow depressions. The same is true of battered joints or cracks that may appear. We consider it economy to have a small maintenance crew go once or twice each year over all the roads in the county. Such a crew consists of a foreman, one team and four laborers. This crew will under average conditions, in Milwaukee County, cover all the joints, cracks and small pits in from one to two miles of eighteen-foot road in one day at a cost of from fifteen to thirty dollars per mile for labor and material. When it is deemed advisable to cover the entire surface the same method of cleaning may be followed excepting that most of the dirt may be removed with a power sweeper and the tar applied with a power sprayer. After the first treatment of one-fourth to one-third of a gallon of tar has been applied a second may be added in the same manner excepting that an asphalt may be substituted for the tar, as it will adhere to the tar already placed where it will not to the concrete. We have several pieces treated in different manners as to materials used, and are looking forward with interest to see what conditions they appear in this spring.

Treatment of concrete roads as a whole, whether necessitated by poor workmanship, defective materials, or freezing, is considered a rather expensive process compared with spending more in the original cost and getting a road of a quality that will not require such a coating for many years. Even if a treatment will last for two seasons, which is very doubtful under conditions of heavy mixed traffic, the cost will come to several hundred dollars per mile per year. Of course, such a coating has some advantages, such as acting as a cushion to horses, preventing wear on the concrete itself, doing away with glare, and being applied without delaying traffic. On the other hand, it makes the road a little more slippery and a little less clean. The writer believes that the time is not far distant when a coating of concrete one or more inches in thickness will be applied to a poorly-built concrete road and made to stay there, thus giving an entirely new wearing surface.

In conclusion, we believe that maintenance varies inversely as the quality and uniformity of the concrete in the road, not arithmetically but more nearly geometrically, are due to the uniform wearing of a uniform concrete.

Concrete Bench Marks

CONCRETE bench marks are set on Oregon State concrete road work near the edge of the right-of-way at different places along the highway where conditions or materials change. For example, where the wearing surface changes from a 1:2 mix to a 1:1:2 mix, a bench mark is set and the elevation stamped upon it. On the pavement, at points 10 ft. each side of the expansion joints, a soft copper wire is set 6 ins. from the edge of the pavement. Measuring from this wire exact elevations, read to thousandths, are taken every foot across the pavement. The object of the wire is to locate definitely a point which can be found at any future time for reference with respect both to longitudinal and transverse measurements. In years to come it will be possible and easy to check the amount of wear on the pavement to within a thousandth of an inch. Having the two measuring points so close together and under the same working and traffic conditions, but with different materials will, it is figured, make it possible to determine the merits of the materials, mixes and cements used. Exact records of every contraction crack are kept. The shape, dimensions and notable features are all drawn to scale.—Engineering Record.

The Road Contractor's Joke

A Devonshire road contractor was being taken to task by his surveyor because he had not the required quantity of road metal broken and ready for use. "What can I do?" the old man asked. "I can get no help. My son, who used to assist me, has joined the Navy, and is now with the North Sea Fleet. Of course, if you tell me I must get the stone," he concluded, "I will send to Sir John Jellicoe—tell him the roads cannot wait, and that he must send my son home."

Street Railway Track Construction and Maintenance

By H. J. Tippett*

The subject of street railway track construction covers a very extensive field, and when one considers that there are somewhere in the neighborhood of forty-five thousand miles of street railway on this continent, and that some of it is costing in the neighborhood of $50,000 per mile of single track, it will be agreed that the original construction and its subsequent maintenance is one full of engineering interests.

The subject could be split up into a great many parts, on account of the materials used and the methods of carrying out the work, and each item could probably be made a subject of a paper in itself, but with the limited time at our disposal it is merely possible to run over the subject in briefest outline.

So much of interest in this subject is bound up in and is virtually a part of the early histories of railways that it was felt the article would not be complete without a brief reference to the origin of ways and the development of materials which are common in railway engineering of to-day.

Historical

The railway track more than any other part of railway equipment had a crude beginning, and has reached its present condition of excellency by a continuous series of improvements.

In the year 1630 a Mr. Beaumont, of Newcastle-on-Tyne, took the lead in a movement to facilitate the conveyance of coal from the mines to points of shipment by means of wooden-ways consisting of cross sleepers or ties placed 2 ft. apart, on which were nailed wooden planks or rails 6 ft. long and 4 in. wide. Like many other pioneers, he lost his entire fortune in this and other schemes for mine development, and died in poverty. His idea, however, lived on and was improved about 1640 by covering the tops of the wooden rails with cast-iron plates to prevent the attrition caused by the wheels. The next improvement saw these plates made with an upright side or flange to keep the wagons on the track. This operation was called plating the wooden rails, from which the appellation "Platelayer" comes, which to this day is the name given to the trackmen in Great Britain. These plates came to be called "Snake Rails," on account of their liability to become loose and suddenly dart upwards, sometimes passing through the floor of the wagon and injuring passengers, and the wagons were often derailed in this way. It became a common practice for a heavy sledge hammer to be carried on the wagons and if any plates became loose the wagon would be stopped and the plate fastened down before proceeding.

With the development of the iron industry the transfer from plated wooden rails to cast-iron rails was a natural one. Cast-iron flanged rails 3 ft. long and 4 in. wide were first used at Whitehaven in 1738. These were made in what was called the "Fish Belly Pattern," that is, with the flange of wider cross section at the centre of the rail than at the end of the rail.

In 1789 William Jessop brought about an important advance by introducing at Loughborough, Leicestershire, edge rails, so called because the wheels ran along the top edge and were not guided by a flange on the rail but by a flange on the wheel. These rails were also cast in 3 ft. lengths and 1½ in. wide on top; they were also of the fish belly pattern, but had projections from the base at each end through which they were fastened to the ties. It was soon found, however, that these projections broke off and then there was no way of holding the rail. This brought about the next great improvement, namely, that of casting a rail holder as a separate chair or pedestal, and this type, though slightly improved, is, as we know, the type in general use throughout Great Britain to-day.

James Outram was also responsible for the laying of railways for Derbyshire Collieries. These were laid about 1795 and were in use as recently as 1911, they were known as "Outram Ways," and later as "Tramways." Whether the word "Tram" was a contraction of Outram or came from the old Swedish word tram, which means beam of wood, is in doubt, but the name "Tramways" still holds good throughout Europe.

Jessop, too, was responsible for the standard 4 ft. 8½ in. gauge, which is universal to-day. It is easily seen how this came about. All his rails were 1¾ in. wide on the head and he made the distance between the rails on all the tracks which he laid an overall dimension of 5 ft.—that is, between outside edges of his rails; this gave a dimension of 4 ft. 8½ in. between what we term to-day gauge edges of the rails.

Some thirty-six years later, when consulted about the width of gauge for his new Stockton-Darlington railway, George Stevenson said, with broadmindedness and foresight, "make it the same as Jessop's—our tracks may be a long way apart at present, but depend upon it, it will not be long before they are connected up."

It was not until 1795 that the first wooden railway was built on this continent; this was on Beacon Hill, Boston, and even thirty years later we find the Quincy Railway, in Massachusetts, 4 miles long, built of wooden rails 6 in. wide and 12 in. high, with the old iron plates or snake rails on top and resting on stone sleepers 8 ft. apart.

In 1825 America was awakening to greater interest in this method of transportation, and sent William Strickland from Pennsylvania to England to collect detailed information on transportation in general and railways in particular.

In 1830 the present-day T rail originated—Robert L. Stevens, of Hoboken, when on his way to England to buy rails for a proposed road, devoted considerable time whittling out cross sections of what he thought would be a good kind of rail. The best then known in Europe was the T rail without any base, requiring a chair on every tie. Stevens spent considerable time in England before he could get a manufacturer to even consider making his rail with the flat base. He held on, however, and succeeded in getting the first H rails, as they were then called, made by promising to accept the responsibility for damage to the mill and possible loss of life that might result from so hazardous an undertaking! These rails were, however, eventually rolled and of wrought iron 16 ft. long, height 3½ in., width of head 2⅛ in., width of base 3¼ in., with a weight of about 39½ lbs. per yard. Stevens never patented his rail and lived to regret his omission to do so. In Europe it was developed by C. B. Vignole, and to-day is more commonly known as the "Vignole" rail on that continent.

It was not until 1855 that iron rails were first manufactured in America. In 1863 Bessemer steel was invented. Thus we find the original ideas of Beaumont, Jessop, Stevenson and Stevens to be the basis of railway track construction to-day.

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Method of Traction

(The method of traction to-day through city streets may be of several kinds—cars may be hauled by horses or cable, operated on the electric conduit storage battery systems or overhead trolley system, the third rail and catenary systems are confined chiefly to interurban railways, which are outside our subject to-night.)

In England the construction of tramways proceeded more rapidly after the passing of the Tramway Act in 1870.

It has been proved conclusively that the overhead trolley system for handling city traffic has been the most economical to adopt from an operating standpoint, and the other systems are more usually adopted to take care of some local features for which they are better suited. Richmond, Virginia, had the first electric motor street railway. This commenced operating in 1888.

The following figures give some idea of how the different systems compare numerically on the North American continent:—

Overhead trolley systems	1100
Storage battery systems (mostly small companies)	50
Cable systems	2
Electric conduit systems	2
Horse traction systems	1
Trackless trolley systems	1

Modern Track Construction

The types of paved track construction for use on overhead trolley systems may be divided into three general groups.

Type 1.—That in which no ties are used; the rails are temporarily surfaced to grade on stone blocks and held to gauge by steel tie rods and are then concreted in solidly, the concrete coming over the rail flange. This type is common in Great Britain.

Type 2.—That in which the rails are surfaced to grade by as few ties as possible, ties being spaced about 8 ft. centre to centre. The rails also held to gauge by steel tie rods and then concreted in. This type has seen limited use on this continent. In these types the concrete is usually deeper under the rail than between the rails, thus forming a longitudinal stringer or concrete beam.

Type 3.—That in which the rails are surfaced to grade on as many ties as can be conveniently placed under them without interfering with the operation of surfacing. These ties are usually spaced 18 in. or 2 ft. centre to centre. In this type the concrete is usually of the same thickness under as between the rails. This is also the most common type in use on this continent, though its details are again split up into different classes to adapt it to local conditions. It closely follows regular steam road practice, and the fact that it is very adaptable to both good and bad subgrades alike has brought it into general favor.

Let us consider foundations for a minute. In comparing types 2 and 3, type 3 makes use of the maximum bearing area attainable on the subgrade. Type 2, however, by the use of a longitudinal concrete stringer under the rail reduces this area to only a little over one-third that of type 3, because it has many less ties and the greater thickness of concrete under the rail makes a line of structural weakness between such longitudinal concrete stringers and the shallower concrete between the stringers. In many cities also the variable nature of the subgrades generally met with in laying track on city streets has proved the necessity of the greatest possible bearing area.

It will be noticed that Philadelphia, Fig. 1, ties the two concrete beams together with reinforcement, nor are the beams as heavy as is the case in Vancouver. In the Cleveland type, again, the stringers or beams are not of so great a depth. In each of these cross-sections it will be noticed that the subgrades require considerable care in preparation, and much of the ground between stringers is liable to be broken up and remade and therefore not so homogeneous and satisfactory as undisturbed ground. In placing the concrete, too, the dirt from the sides of the trenches is liable to be mixed with it. On account of settlement of made ground and the difficulty in holding the rails, owing to there being so few ties, this type has not been very successful here.

Referring to other details of Fig. 1, I would just mention that the left-half is a cross-section of the construction at a tie or chair, and the right-half a cross-section through the rail joint, to show the different types of joints used. In this old Vancouver type the ties were only 7 ft. long; we have increased these to 8 ft. long in the new type, which will be noted later. No tie plates were used under the rail, and the joints were of what was called the "reinforced" type; that is, a piece of rail 4 ft. long of the same section was inverted and riveted onto the base of the two abutting rails. This had the advantage also of acting as an anchor. The rail 7 in. deep, weighed 70 lb. per yard, which while admissible on light traffic lines is not suitable for the down-town traffic of to-day.

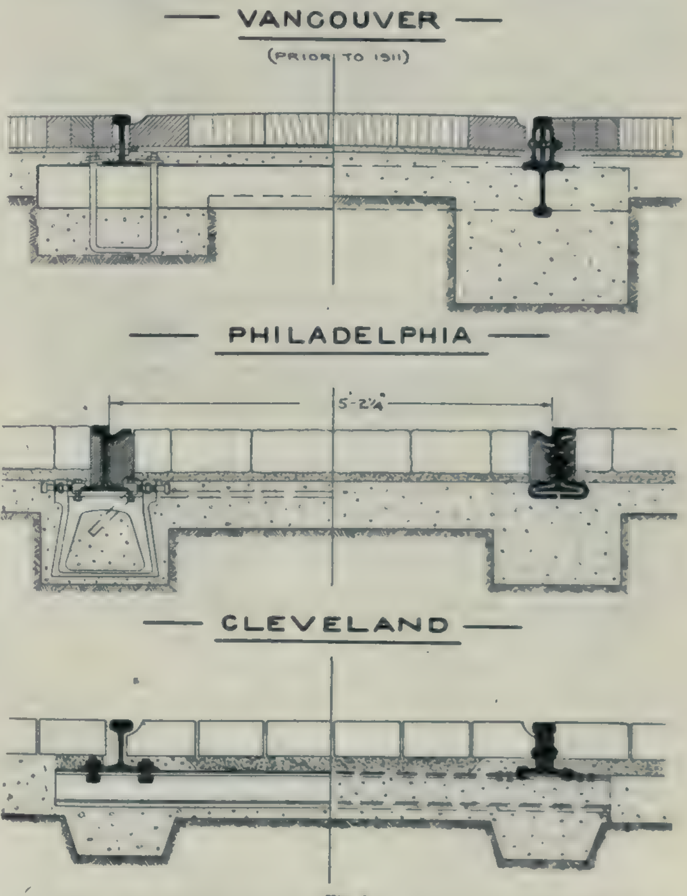


Fig. 1

VANCOUVER (Prior to 1911)- Concrete, 1:2½:5; ties, 6 in. x 8 in. x 7 ft., 8 ft. c. to c.; spikes, R. R. 9/16 in. x 5½ in.; rails, 7 in. 70-lb. Tee; joints, reinforced; bonds, two 3 ft. plugs; tie rods ¾ in. round.

PHILADELPHIA Concrete, 1:3:6; ties, none, C. I. chairs used 4 ft. c. to c.; spikes, ¾ in. bolt with clip; rails, 9 in. 91-lb. groove; joints, Nichols composite; bonds, none; tie rods, none.

CLEVELAND Concrete, 1:6; ties, Carnegie steel 4¼ in. x 6 in. x 6 ft. 6 in. 4 ft. c. to c.; spikes, bolt and clip; rails, 7-in. 95-lb. Tee; joints, Clark rivet and welded; bonds, none; tie rods, ⅜ in. x 2 in. 5 ft. c. to c.

The effect of lateral pressure exerted by wood block pavement on a too light rail is often considerable, the rail being insufficiently stiff and insufficiently fastened to resist such pressures, which are sometimes considerable. The

Philadelphia type has no ties, but cast-iron chairs are substituted; these are spaced 4 ft. centre to centre. The rail joint is of the Nichols type. The fish plates, which are not made to fit the rail top and bottom, are riveted onto both sides of the web with twelve 1-in. rivets, the space at the top and bottom being then run with zinc—no electric bonding is required.

The Cleveland type calls for steel ties exclusively, and to overcome the increased liability to rail corrugation from so rigid a type of construction the carbon content in the rail steel has been increased from .75 to .8 per cent., and the rail steel is also treated with .1 per cent. of metallic titanium alloy to offset the tendency to brittleness. The steel ties are spaced 4 ft. centre to centre. The Clark joint is used. In this the plates make a tight fit with the rail at all points and eight 1⅛ in. rivets are put in under considerable pressure and the base of the rail is thermit welded—no electric bonding is required.

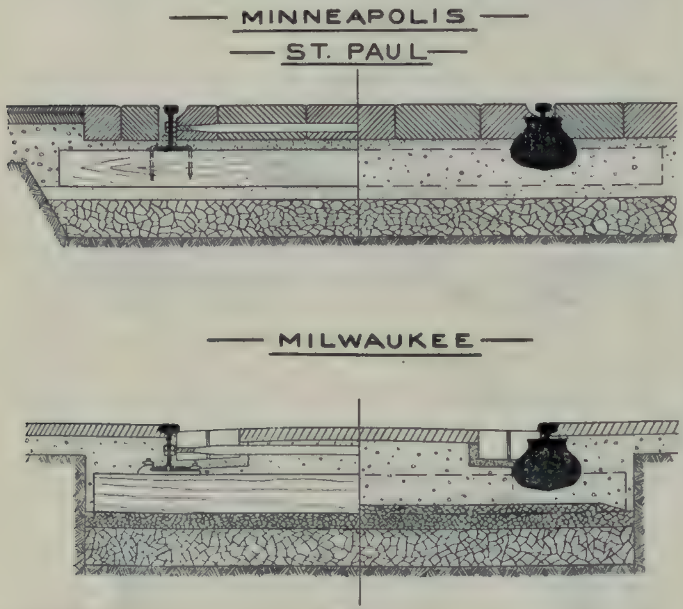


Fig. 2

MINNEAPOLIS, ST. PAUL—Rock ballast, 6 ins. rock and 2 ins. gravel under ties; ties, creosoted pine 6 ins. x 8 ins. x 8 ft. 2 ft. c. to c.; spikes, R. R. 9/16 in. x 5½ in.; rail, 7-in. 91-lb. Tee; joints, cast welded; bonds, none; tie rods, ⅞ in. x 1½ in. 10 ft. c. to c.

MILWAUKEE—Rock ballast, 8 in. under ties; ties, pine, white oak 6 in. x 8 in. x 7 ft. 24 in. c. to c.; spikes, ⅞-in. screw; rail, 7-in. 95-lb. Tee; joints, cast welded; bonds, none; tie rods, 5/16 in. x 2 in. 6 ft. c. to c.

As previously stated, that type in which the ties are more numerous, is the most popular on this continent. This type may itself be subdivided into three classes:—

Class A, where the ties are laid on a crushed rock or gravel foundation requiring drainage, with no concrete under the ties.

Class B, where the ties are laid temporarily on blocking at each end and are then concreted solidly in, in one operation.

Class C, where the ties are placed on a previously laid concrete slab and then surfaced to grade on a cushion of sand or fine rock and the remaining concrete put in after the track proper is completed. Other types than these are considered in the light of exceptions to the general rule.

The type using the crushed rock or gravel foundation is quite popular in a number of important cities. It has, nevertheless, been abandoned in others, owing to the poor bearing qualities of the soil, good bearing qualities being essential to the use of this type. Those using it did so usually because—First; they avoided the ten days which must be allowed for a concrete foundation to set, and therefore they can turn traffic onto it with a minimum interruption to the car service. Secondly; because it is claimed to be more resilient and therefore less noisy and less conducive to rail corrugation than when the track is laid on concrete. Good as such a foundation may be if well rolled and drained, it is not to be recommended where the subgrade lacks uniformity, as the crushed stone does not act as a unit in the same way as concrete, the load on each tie being transmitted to the subgrade independently, and for this reason it is not possible to provide against settlement of the track over sewer or water trenches so often cut across the tracks, or holes that have been back-filled. This is perhaps its most serious drawback, particularly in new cities. In reconstructing this class of track it is not necessary, of course, to excavate deeper than the bottom of the ties.

Milwaukee, Minneapolis and St. Paul construction (Class A foundation) is shown in Fig. 2. Minneapolis uses gravel or rock; sometimes neither, however, is necessary, as a good natural gravel runs up to the surface of the ground in many places which is taken advantage of, the ties being laid directly upon it. If crushed rock is laid the ties are surfaced up with gravel; this tends to fill the voids in the top of the rock and to prevent the lighter mortar in the paving concrete from running away from it. The rails, 91 lb., 7-in. "T" rail, are the same as used recently on some Vancouver work; the fasteners, regular railroad spikes and tie rods. The joints are of the cast welded type; these are made by running molten steel from a portable cupola into moulds clamped around the abutting rail ends, making the rail to all intents and purposes a continuous one.

Milwaukee uses a rather greater depth of rock under the ties, 6 in. being of coarse material with 2 in. of finer material on top. Rails 95 lb., 7-in. "T" fastened with screw spikes, tie plates and tie rods being also used. Milwaukee is the home of the cast welded joint just described in Minneapolis.

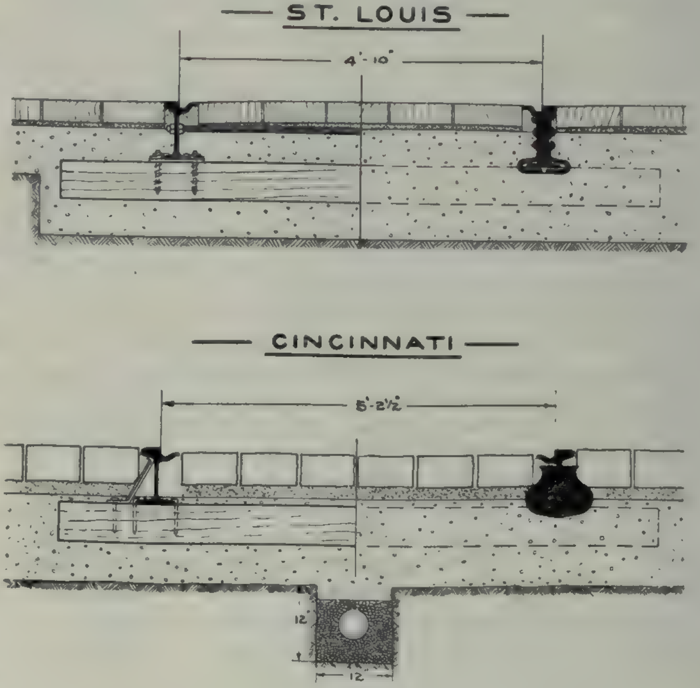


Fig. 3

ST. LOUIS—Concrete, 1:3¼:6½ 6 in. under tie; ties, write oak 6 in. x 8 in. x 8 ft.; spikes, screw and clip; rail, 9-in. 132-lb. groove; joints, Nichols; bonds, none; tie rods, ⅞ in, round 6 ft. c. to c.

CINCINNATI—Concrete, 1:3:7: 6 in. under ties; ties, white oak 6 in. x 8 in. x 8 ft. 2 ft. c. to c.; spikes, R. R. 9/16 x 5½ in.; rail, 9-in. 140-lb. groove; joints, cast welded; bonds, none; rail brace, every 4th tie.

In St. Louis and Cincinnati, Fig. 3, we see two examples of Class B construction, where the ties are entirely surrounded with concrete in one operation. The resiliency acquired in the types we have just seen is not secured in this type; in fact it is quite the opposite extreme; yet the wood ties themselves do absorb a certain amount of vibration that would not be the case were steel ties used. To reconstruct this track it is necessary to excavate right down to the original subgrade. The St. Louis rail is 9 in. deep, weight 132 lb. per yard, and fastened with screw spikes; clips, tie plates, and tie rods being also used. For joints, the Nichols type as already described in Philadelphia.

Cincinnati uses a 9-in. rail, 140 lb. per yard, fastened with railroad spikes and rail braces on every fourth tie, in place of tie rods. The cast welded joint is also used, as described in Minneapolis. Attention is drawn to the width of the gauge in these two cities as not being standard.

Both Dallas and Seattle use 7-in., 80 lb. "T" rail, and ties a foot shorter than the popular 8-ft. length, both also use continuous joints. Dallas, however, prefers rail braces every third tie to the use of tie rods, and in addition uses anchors between every other tie. Seattle uses tie rods and no anchors. While speaking of Seattle we might stop a moment to consider a new rail joint that originated some two years ago in that city. This joint will strike you perhaps as something new. The principle sought for in all rail joints is, of course, the elimination of relative motion between the rail ends while still permitting the necessary wave motion for sake of resiliency. This principle has been more scientifically worked out in this case. The top of the angle bar has a slight camber to insure a tight fit under the head of the rail at the immediate rail ends. At the same time the centre at the bottom of the angle bar is undercut to permit of the wave motion, the load applied at the joint is distributed to both ends of the angle bar and thence against the base plate, into the slightly tapered sides of which the bar becomes wedged tighter and tighter as the traffic continues. With this type of joint, bolts are claimed to be unnecessary, but for convenience in putting the joint together are sometimes used. The angle bars are prevented from the unlikely possibility of lifting out of the base plate by an ordinary track spike or lag screw. The base plate fulfils another important function, that of an anti-rail creeper. This is secured by that curved contact between the base plate and the angle bar tending to prevent the longitudinal slip, the base plate also turning down on both sides of the tie. This is the only joint there is time to explain, and as it is one of the latest it should be of interest, since it attempts to solve several problems at once and at present is standing the test satisfactorily. Around Seattle quite a number are already in the track, but as yet we have only one as a sample on our Vancouver system, which was installed last September; it has apparently eliminated the relative motion and is now a good deal tighter than the day we put it in.

Class C. construction. That is the Vancouver type, in which the concrete foundation slab 6 in. to 8 in. deep is first laid on the subgrade, and as soon as it will bear the ties without damage the track is laid upon it with ties spaced 2 ft. centre to centre; this operation completed, the track is rough lined and is then surfaced to grade by wood blocking under the ends of the ties, using factory clippings from lumber mills and No. 2 shingles; the latter, owing to being tapered, admit of very nice work in bringing the track absolutely to grade. Sand is then thrown into the track and tamped under the ties to entirely fill the space between them and the concrete slab. The surplus sand is roughly scraped from between the ties, a final lining up is given, and the track is then ready for the second concrete operation, which concrete is to form part of the paving foundation proper. This, of course, varies in depth according to the city's requirements and the particular type of paving adopted for the street.

The claims for this type of foundation are: First, that the sand cushion on the concrete slab gives the required resiliency secured in the rock ballasted type without the liability of that type to settlement, as the concrete slab readily admits of reinforcement over sewer trenches or bad ground; and second; that it does not make the provision of subdrainage a necessity, since there are no voids, as in the rock ballasted type, to invite water to collect under the track; and, third, the greatest economy of all, the reduced cost of reconstruction from the fact that the concrete slab foundation, being as it were a separate unit, has been placed once and for all and need not be removed. This saving means approximately 20 per cent. of the cost of reconstructing such track. We are indebted to Mr. C. B. Vorce, formerly construction engineer of the British Columbia Electric Railway Company, who in the spring of 1911 laid the first stretch on Granville Street from Hastings to Robson, just four years ago, for the introduction of this type into Vancouver. This type permits advantage being taken also of good hard ground sometimes met with in cuts to reduce the depth of the slab to 4 in. or 5 in., and similarly to increase its depth to 7 in. to 8 in. over fills of poorer ground. Note the distinct line of separation, Fig. 4, between the concrete slab and what we call the filling concrete. Vancouver and Detroit both use 1 in. of sand cushion, while Buffalo prefers 2 in. of fine rock cushion. Vancouver and Buffalo use continuous joints; Detroit the cast welded joint; Buffalo uses screw spikes, and each of the three uses flat tie rods.

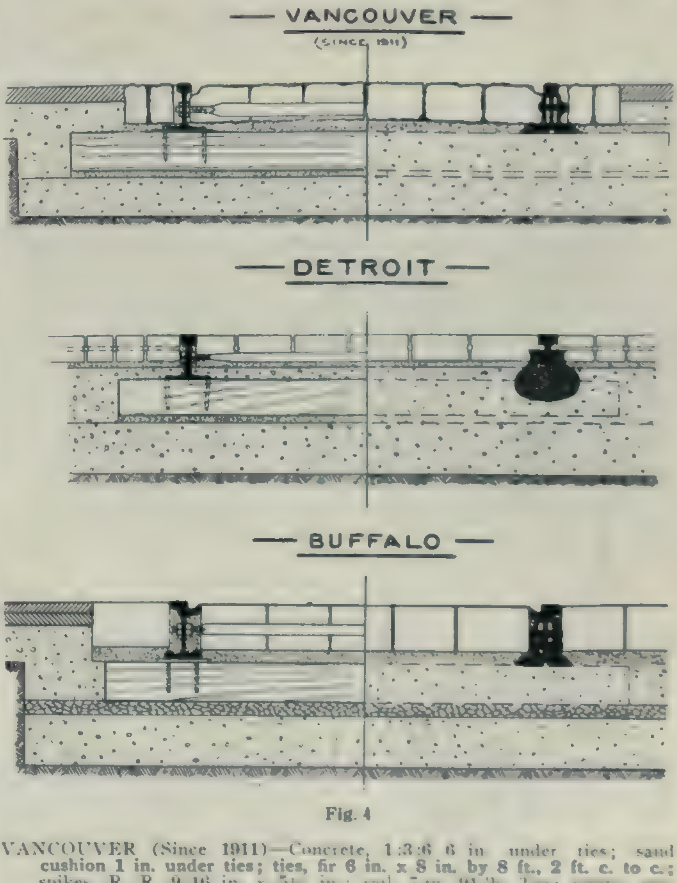


Fig. 4

VANCOUVER (Since 1911)—Concrete, 1:3:6 6 in. under ties; sand cushion 1 in. under ties; ties, fir 6 in. x 8 in. by 8 ft., 2 ft. c. to c.; spikes, R. R. 9/16 in. x 5½ in.; rail, 7-in. 91-lb. Tee; joints, continuous 6-hole; bonds, two 10 in., ⅜ in. terminal soldered; tie rods, ⅜ in. x 2 in., 6 ft. c. to c.; tie plates, ⅜ in. x 8 in. x 9 in. oak or gum on all ties.

DETROIT—Concrete, 1:2:4 8 in. under ties; sand cushion, 1 in. under ties; ties, white oak 6 ins. x 10 ins. x 6 ft. 8 ins. 3 ft. c. to c.; spikes, R. R. 9/16 in. x 5½ ins.; rail, 7-in. 91-lb. Tee; joints, cast welded; bonds, none; tie rods, ⅜ in. x 1½ in. 6 ft. c. to c.

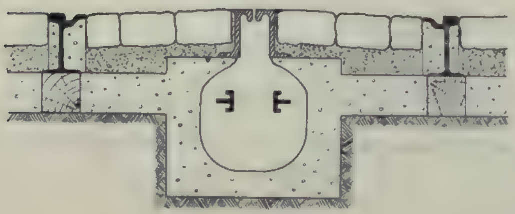
BUFFALO—Concrete, 1:3:5 8 in. under ties; rock cushion 2 in. under ties; ties, pine 6 ins. x 8 ins. x 7 ft., 2 ft. c. to c.; spikes, screw spikes and fetter drive screw; rail, 9-in. 124-lb. groove; joints, continuous 8-hole; bonds, one 10-in., one 12-in. comp- terminal; tie rods 5/16 in. x 2 in. 6 ft. c. to c.; tie plates, on each tie.

It would not be right to omit mention of an interesting exception to the types shown. San Francisco, using the crushed rock foundation, still further reduces the amount of concrete used by raising the crushed rock between the rails. This city, by the way, had the first cable system; this was installed in 1873.

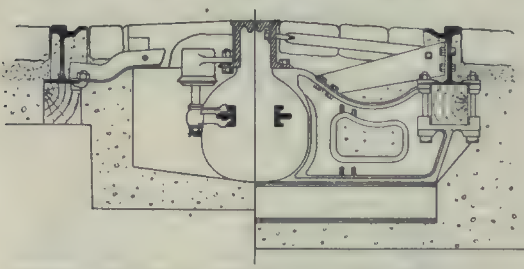
Regarding the types as used on the new viaducts in Vancouver, that on the Georgia-Harris viaduct is of the all-steel and absolutely rigid type of construction, everything below the base of the rail being concreted solidly in. The legs rest on form boards to support the track, while the concrete, which is also to form a part of the viaduct structure itself, is poured around it. On account of this construction being solidly concreted in, it will be more expensive to reconstruct than in the case where the track is made a unit separate from the bridge structure itself. In the case of the tracks on the Hastings street viaduct, this point was borne in mind, the type adopted is just a slight modification of B. C. E. R. standard type. In this the tracks were made a separate unit and in the construction of the viaduct a track allowance to a depth of 10 in. below top of rail grade, was left to permit of the tracks being laid later. To make the best use of this 10 in. depth, a rail 4¼ in. deep on a steel tie plate ¼ in. thick on a tie 4½ in. deep left 1 in. for our usual sand cushion, steel screw spikes with clips, were used for the first time by us on this work and proved to be a very excellent type of fastening.

NEW YORK

CONDUIT CONSTRUCTION



CROSS SECTION BETWEEN YOKES



CROSS SECTION AT YOKE

Fig. 5

Our old method of removing the concrete stringer construction by hand was a somewhat laborious task. The new way, which we do not find nearly so difficult or expensive, entails the use of a Thew steam shovel, which digs up our old concrete stringer construction very satisfactorily without previous breaking up. Some of these pieces were about 7 ft. long, 2 ft. wide and 1 ft. thick, weight about 2,000 lb., and are loaded onto a 3-ton Packard auto truck; this truck has been another great money-saver, doing on an average the work of about four teams. Prior to using the steam shovel on this class of excavation we used a heavy concrete breaker; this was an electric shovel with pile driver leads attached and using a 2,000 lb. hammer. It was a great help at the time, though it is hardly likely that the breaker will be used again, seeing the shovel will excavate the old concrete without previous breaking.

The steam shovel is also used to excavate the brick allowance for ordinary paving work as well as on reconstruction work. Form boards are set immediately behind the shovel, the top of the form board being the top of the concrete slab, which is about to be laid. The use of these form boards helps to construct the slab accurately to grade. The distance between the form boards, or in other words, the width of the track allowance is 18 ft. 6 in. for double track. Where trenches have been cut across for water or sewer work and the steam roller has not been over them, the slab is reinforced, usually with expanded metal lath to guard against settlement. The practice of building up deep fills in layers as laid with a steam roller is believed to give more uniform and better results than that of puddling a fill, since uniform puddling is very hard to secure and results often in soft spots, which in many soils refuse for a long time to dry out. In the one case you know what you have got and in the other there is considerable uncertainty. The original temporary track is thrown over to the side of the road, but sufficiently close to the new track allowance to permit of material for the concrete to be delivered to the excavation from steel 5-yd. side dump Koppel cars by work trains operating between the bunkers and the job.

The navvy-jack gravel is delivered ahead of the mixer which is laying the concrete slab. The concrete is in proportion of one of Portland cement, which is required to pass standard specifications, to nine parts of navvy-jack gravel, which must consist of two-thirds gravel and one-third sand; this gravel may be pit run, but fresh water gravel is cleaner. The proportions of one-third sand and two-thirds gravel are insisted upon and a sample is tested on the ground from every five yards delivered. If the proportion varies more than three per cent. either way additional material is delivered to correct the deficiency.

In Vancouver we use a second concrete mixer running on the rails and filling in the newly laid track. This type of mixer is well suited to this type of work; there are no wheelbarrows at the delivery side of the drum, but the concrete from the drum discharges into a bucket running on a 30-ft. boom which can be swung in any direction required. Templates for striking off the concrete to the right height are used, and along the rails inside the track form boards to permit of difference in levels for the paving which is to be laid, the granite flangeway blocks in this case being deeper than the wood block paving to be laid between them.

The granite flangeway blocks are grouted in place with two to one sand and cement, prior to laying the wood block paving.

It would not be right to close without reference to the material used for special work at junction points, though this is a large subject in itself and difficult to touch lightly upon. The installation of the junction at Main and Hastings streets was completed in 1912. The new steel for this junction cost $13,700. There are four types of special work construction, but there is only time to go into two, however, for purposes of comparison. These are commonly known as manganese insert construction and solid manganese construction. The previous layout was installed in 1904, and was getting into bad shape some six years later, but with considerable tinkering we managed to keep it in the ground for two years more. The switches, frogs and crossings were of the manganese insert iron-bound type of construction; that is, a plate of manganese steel is inserted at the point of greatest wear, which, of course, is the point of intersection of the two rail heads. The plate was bedded on spelter and keyed down, the arms, which are short pieces of rolled rail of the required section, are set in place in a mould and then cast-iron is poured around them to hold them fast. Special work built in this way has unfortunately been prolific of much trouble in comparison with the solid manganese type. Attention is drawn to the number of different parts that go to make up a crossing. There are the four arms, the manganese insert, the keys which fasten it down and the cast-iron body—we might say seven pieces at least. Then look at the different metals used in its make-up—open hearth steel rails, manganese steel insert, zinc spelter bed for the insert, and cast-iron body—four different types of metals and two of these are in direct contact with the rolling load, namely, the insert and the rails and through them the load is transmitted to the spelter bed and the cast-iron body; could one reasonably expect uniform results from such a miscellaneous collection? This point is worthy of attention, because most street railways on this continent are suffering from this very complaint.

One has only to compare the results of wear on manganese steel and wear on open hearth steel to answer that question. Tests have proved that wear on open hearth steel is about seventy times as rapid as on manganese steel, so that the insertion of a piece of manganese steel between two pieces of open hearth steel defeats its own object, and in endeavoring to eliminate excess of wear at one point it creates uneven wear at four others, namely, on all dies of the insert where the two steels join. This often results in damaging the crossing permanently by breaking the arms loose in the casting. Another mechanical fault, and surely it was one, was to set the insert on a spelter bed. The insert's object is to eliminate wear and it should therefore be provided with an absolutely solid foundation. This can only be secured by machining the surface of the cast-iron body and the underside of the insert and by bolting it down. The fault with the spelter was, of course, that, comparatively, it was a soft metal and unable to withstand the shock or impact of the passing load without flowing and it consequently quickly permitted the insert to work loose. Some cities have so much of this type of special work as to make it necessary to have a track gang doing nothing but resetting loose inserts, and since every manufacturer has a different method of fastening the inserts, considerable experience is necessary to make such repairs with rapidity and economy. In comparison let us consider for a moment the Vancouver junction, which shows the solid manganese steel type of special work which was used when renewing this special work junction in 1912. Each insert crossing was made up of seven or more pieces, each crossing in this case in one single piece. The insert type combined the use of three types of steel as well as spelter; in the type before us solid manganese steel alone is used. Solid manganese special work was adopted for junctions in Vancouver as far back as 1907 and is now standard for our heavy traffic junctions, and has given eminent satisfaction. While for plain rails solid manganese is only used where very heavy traffic is to be catered for, such as around the library corner, solid manganese has not been used entirely for all plain rails on our special work throughout, as it is believed that this would be going to unnecessary expense. The plain rails, therefore, are usually of open hearth steel, and while it is admitted that uneven wear will in time show up where the manganese steel joins the open hearth steel, yet these places are not so close together as in the case of insert work, nor does such wear have any damaging effect upon the crossing.

An appliance has recently been invented whereby new steel can be electrically welded onto worn rail surfaces. Street railway companies on every continent were just looking for some such appliance, and its possibilities in repairing special work and in postponing re-construction on account of bad rail joints has given this appliance a most enthusiastic reception.

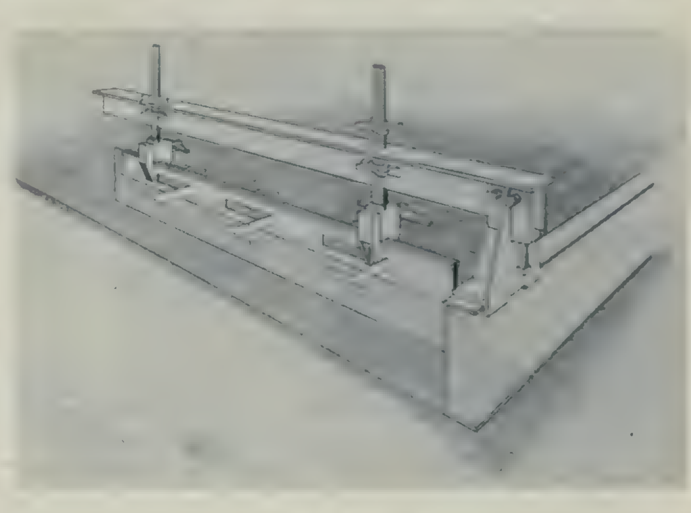
It is only fair to say that probably no track ever invented has ever saved street railway companies more dollars than the Electric Arc Welder. Much track which would otherwise have been scrapped has by the use of this welder been given a new lease of life.

Elimination of Expansion Joint Difficulties in Concrete Road

H. J. Stambaugh, Jr.

THE extensive experience with concrete roads in recent years and under practically every existing condition has definitely established certain facts. Unless artificial transverse expansion joints are provided when the road is laid, irregular cracks will occur on an average of from 25 to 50 feet along the length of the roadway.

To depend upon these irregular cracks to take care of the expansion and contraction of the roadway is, of course, not desirable, in fact it is dangerous to the success of the pavement. The irregular cracks indicate that the concrete has been pulled apart over a considerable area and at points which are the weakest parts of the pavement, causing additional strains on these weakened sections. The irregular edges, formed by such cracks, cannot be protected and readily break down and form a bad spot in the pavement.


Details of construction.

The necessity of providing expansion joints at regular intervals is thus apparent. The next point to consider is the adequate protection of the edges of this joint, as it is generally recognized that such protection is necessary. The edges of concrete must be protected from breaking and chipping away, and to do this satisfactorily the edge protector must be tougher and more tenacious than the concrete, so that it will stand up under the pound and wear of traffic.

Steel protection for joints offers the best solution of this problem, but some of the earlier methods have not proved entirely satisfactory. Sometimes the quality of the steel used has been too hard or the shape of the plates such that a sharp angle of concrete was left exposed back of the plate, with the result that there has been a tendency for the concrete to start chipping back of the plate. In some instances the plates have not been installed correctly.

It is unfortunate, but nevertheless true, that the majority of engineers who have supervised the construction of concrete roads have not given sufficient thought and attention to the character and type of protection plates and the method of installing them. Too little attention has been paid to the character of the steel from which the protection plates were made. Not sufficient consideration has been given to a means of securely anchoring the protection plate to the concrete slab. Very few have taken into consideration the fact that the shape of the protection plate governs to a great extent its successful use. Too many have relied upon the contractor, or the manufacturer, for a satisfactory method of installing the protection plates, so that they will not extend above or below the true surface of the road.

These factors are of just as much importance as the matter of proper sub-grade, drainage, measuring and mixing, finishing, etc.

Protection plates should be manufactured from new billets of extremely soft open hearth steel, which will maintain its tough, tenacious quality while still being so soft that it will wear down evenly with the surface of the road. Any rolling mill can furnish steel of this grade, which is called "dead soft" and has a carbon content of .05 to .12 per cent. Steel of this kind can be readily chipped with a knife.

As a means of anchoring the plate to the concrete slab, strips of the protection plate 6-in. long, and at least ¾-in. wide, should be sheared out at regular intervals of 12 in., and the ends of the anchors thus formed should be slit in half for a distance of about two inches. The anchors should be bent back at right angles to the plate, and the slit ends bent in opposite directions so that they rest at right angles to the anchor and parallel to the plate. An anchor of this type will securely bind together the concrete for a distance of 4 in. or 5 in. back of the plate, and any wear that is to occur at this point will necessarily have to begin at least four inches back from the expansion joint. Except where a very poor grade of concrete has been used, there is no possibility of the latter occurring.

Protection plates should not be manufactured from flat steel. Where protection plates of this type are used, the concrete meets the protection plate at a right angle, and a sharp edge of concrete is formed, which readily breaks down and chips away behind the plate. Protection plates should be manufactured from bevelled edge channel section, having a height of 2½ in., web thickness of ⅛ in., top wearing surface of ⅜ in., and weighing at least 1½ pounds per lineal foot. Such a plate, on account of its shape, will be much stiffer than the types generally used, will not be so apt to lose its crown through rough handling in transit, and can be more easily handled and installed by the contractor. Furthermore, the beveled edge of the plate eliminates the square corner of the concrete and produces an obtuse angle in the concrete back of the plate, preventing the concrete from being chipped off.

The inverted "T" bar type of installing device, now in general use, is entirely unsatisfactory, and the sooner its use is discontinued the better. It is customary to curve this type of installing device to the correct crown of the road, before same is shipped from the factory, but even with the most careful handling, it cannot be made to keep its crown, as it will sag of its own weight. After being used for a very short time, the device must be returned to the factory for recrowning, or the plates being installed will extend above or below the surface of the road. This device completely hides the top surface of the protection plates from view, so that it is impossible to see if they are placed where they should be placed, until the device is removed. Further, it prevents the contractor from finishing the pavement over the plates at the time he finishes the rest of the surface, and when finally removed allows the plates to fall away from the filler—and materially increase the width of the joint.

An installing device constructed along the lines of the accompanying illustration eliminates all the disadvantageous features of the inverted "T" bar type and is as nearly foolproof as anything can be made. This device differs radically from the inverted "T" bar type, as may be clearly noted. The supporting "T" bar extends straight across the road from curb to curb. At either end of the supporting "T" bar is a stool 6-in. high which rests upon the curb or side form holding the "T" bar rigidly in place. These stools can be moved to any position along the supporting "T" bar, so that an installing device, say 25 feet long, can be used for various widths of roads up to 25 feet. The stool is also provided with an adjusting bolt by which the entire assembled joint can be raised or lowered, thereby assuring absolute accuracy of alignment of plates with finished roadway.

Along the supporting "T" bar, at intervals of two or three feet, suspension clamps should be placed, which can be raised or lowered to conform to the crown of the road. The jaws of these clamps are brought together by means of the beveled wedge clearly illustrated. The faces of the jaws are just long enough to fit between the beveled edges of the protection plate, so that when once the suspension clamps are set to the correct crown of the road, the protection plates must conform to the same crown. Otherwise the jaws of the clamp cannot be brought together, and the danger of the plates extending above or below the true surface of the road is entirely eliminated.

Another advantageous feature of the device is that practically the entire top surfaces of the plates are at all times visible, and the contractor can finish the roadway evenly over the plates, before removing the installing device. It also permits the contractor to soundly tamp the concrete behind the protection plates without forcing the plates from their true position; and last, but by no means least, should the supporting "T" bar develop sag, either through rough handling or from the weight it is called upon to support, such sag can be readily and quickly taken up by merely re-adjusting the suspension clamps.

Errors Result in Increased Cost of Parliament Buildings at Winnipeg

AT Winnipeg the Public Accounts Committee is holding an inquiry into the increased cost of the new Parliament Buildings which are being erected for the province in that city. The original contract price of the buildings was $2,859,750, and the cost with the additions now contracted for is roughly $4,100,000. Upon examination, the Provincial Architect, Mr. V. M. Horwood, explained the reason for the changes which had been made in the architect's plans.

There had been 369 caissons sunk, he said, and they ranged from 4 feet 6 inches in diameter to 18 feet square. The largest ones, 10 or 12, were under the dome part. As tending to show the necessity of using caissons instead of piles, as originally specified, the architect said a great many of the best buildings in Winnipeg were on caissons. He instanced the Union Bank Building, the Fort Garry Hotel, the new addition to the Royal Alexandra, the Electric Railway Building, the addition to the grain exchange, the Confederation Life Building. Bed rock foundations were required for heavy buildings because the soil of Winnipeg, like that of Chicago, was "the worst in the world." It was full of water. Had the Parliament Buildings been erected on a floating foundation, the construction of an adjacent building might have caused the Parliament Buildings to drop an inch, and crack. Cases of that kind had come under his notice in Winnipeg. The Rosemount Block was one. It had cracked across the front as the result of the building of another structure. The Parliament buildings were to be much heavier than any of the other buildings he had named. Some of the walls were 10 feet thick, and this was purely for architectural effect. Of stone construction, this dome would be one of the most substantial things of its kind in North America. The weight on each of the dome piers would be 48,000 pounds, and the dome would be 222 feet high. Trouble had occurred with other buildings in this vicinity, which had been built on a floating foundation. The C. P. R. elevator at Transcona, which had tipped over, was one, and the Canada Cement Company had had a buildings, carrying two and a-half tons a square foot, split to pieces from the same cause.

It was pointed out to Mr. Horwood that he knew the need of bedrock foundations in the Winnipeg soil long before the contract was let. Why had he not advised the Government that the plan of test-holes prepared by the Department of Public Works did not go down to bed rock? Why had he not advised the Government as to the unsatisfactory nature of pile foundations? Mr. Horwood replied that when a man with a reputation like that of Mr. Simon undertook a contract, it was not usual to criticize him until he had made mistakes.

The inquiry is proceeding.

The Canadian Westrumite Company, Limited, of Brantford, Ont., has been incorporated with a capital of $4,000. The incorporators are C. S. Towle, W. G. Coats, W. D. Preston and S. Moon, all of New York, also W. T. Henderson, of Brantford.

Under the name of B. & L. Granite Company, Limited, there has been incorporated at Montreal, with a capital stock of $149,000, a company which will acquire the quarry now operated by Joseph Ledoux, and exploit quarries generally. The Provisional Directors are J. Ledoux, O. Benoit, G. Beauregard, D. A. Leonard and E. Beauchamp, of Montreal.

The Algoma Steel Corporation, Limited, Sault Ste. Marie, have resumed operations with their 12-in. and 18-in. mills, making bar steel, rounds, squares and flats, twisted bars for reinforced concrete, light structural shapes, and light rails of all descriptions. The Montreal office in the McGill Building has been re-opened under the charge of Mr. G. A. Irwin.

From Messrs. Aird Murray & Lowes we have received a copy of an interesting brochure which describes and illustrates by photographs plans and diagrammatic profiles several sewage disposal works of recent construction in Canada. Concise descriptions are given of the disposal works at Lethbridge, Weston, Mount Dennis, Whitby, Dundas, and Carleton Place, as well as several useful illustrations showing special designs with reference to sewage filters, etc., to meet Canadian climatic conditions. The development of the two-storey sedimentation tank as installed in connection with several Canadian disposal plants is graphically illustrated. The booklet cannot fail to be informing and valuable to municipalities contemplating works of this character. Copies may be had by application to the authors, 186 King Street West, Toronto.

One result of the recent visit to St. John of Mr. Thomas Adams, of the Canadian Conservation Commission, has been the decision on the part of the Town Planning Commission of the city to enter upon a comprehensive scheme of town planning. The city proper will not be affected by the proposed scheme to a very large extent, the area that has been selected being the suburban sections. The area embraced is at least three times as large as the present city. On the east it includes a section about three miles in width along the shores of Courtenay Bay to Anthony's Cove, Red Head. To the north all the lands as far as the Kennebecasis River are included. On the west it takes in some fine residential areas in Lancaster, running as far as the bay shore in one direction and as far as Greenhead on the St. John River in the other. The map of this area will be prepared at once for the endorsation of the provincial legislature.

Personal Mention

Mr. J. M. Gibb, a well-known local contractor of Wallaceburg, Ont., passed away recently.

Mr. John Burke, Treasurer of the United States, has succeeded the late Mr. Lee McClung as Treasurer of the American Highway Association.

Mr. J. F. Rhodes has been appointed Publicity Manager of the Canada Cement Company, in succession to Mr. L. S. Bruner, resigned.

Mr. George A. Ricker, M. Am. Soc. C.E., has been appointed Consulting Engineer to the New York State Commission of Highways.

Mr. W. H. Ellicott, Sales Manager of Miller Bros. and Sons, Limited, Montreal, died on March 14, aged 37. Mr. Ellicott, who died from pneumonia, was for twenty years with the firm, who are engineers, millwrights, and machinists.

Mr. Allan Purvis, manager in charge of construction and power of the British Columbia Electric Railway Company, has been appointed superintendent of the C. P. R. lines west of Toronto to Windsor. He is an old C. P. R. official.

As a temporary measure, Sir George S. Gibb, Chairman of the British Road Board, has been appointed an additional civilian member of the Army Council. In that position he will be charged with the supervision of army contracts.

Mr. James H. MacDonald, formerly State Highway Commissioner of Connecticut, has opened an office for practice as a consulting engineer in the Chamber of Commerce Building, New Haven, Conn.

Mr. Thomas Adams, the well-known English town-planning expert, who is now Adviser to the Canadian Conservation Commission, will address the International Road Convention at Toronto on the afternoon of Thursday, March 25, taking for his subject "Town Planning."

Mr. C. E. Hastings was elected President and Mr. W. H. Honeywell Vice-President at the annual elections of the Engineering Society of the S. P. S., held last week at the Convocation Hall, Toronto. Mr. R. S. C. Bothwell becomes Corresponding Secretary, and Mr. J. McEachern, Recording Secretary.

Major W. W. Crosby, Consulting Engineer, Baltimore, Md., for several years Treasurer of the A. R. B. A., has charge of the course in highway engineering in the Extramural Division, New York University. This and the other courses in the division are offered by the University for those in the engineering service of the City of New York.

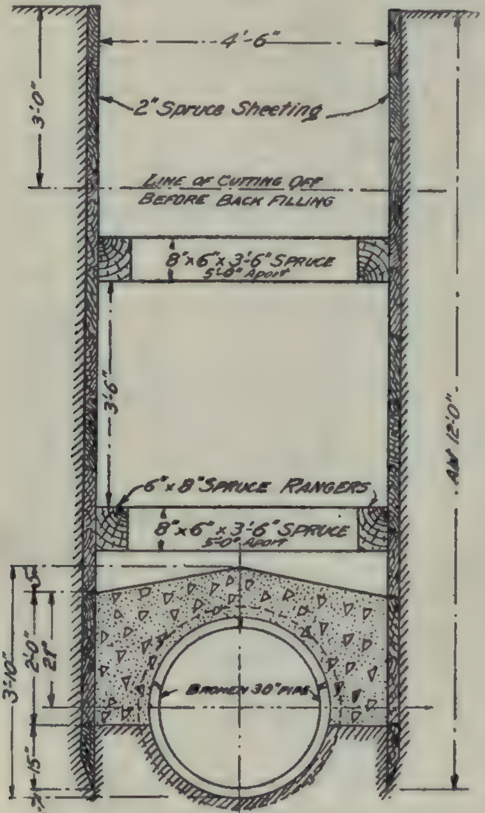
A deputation from the Montreal Builders' Exchange interviewed a special committee of the City Council on the subject of a fair wage schedule proposed to be paid by the city and to be incorporated in all contracts let by the Council. The Exchange objected to the schedule on the ground that it was too high, especially under present conditions, and that some of the rates were above those fixed by the trades unions. The committee have revised the scales, and have asked for the comments of the directors of the Exchange upon the new rates.

Repairing a Cracked Sewer

By Lewis B. Lawrence*

IN 1889 the city of Passaic, N.J., had a 30-inch storm water sewer built on Hope Avenue, for a length of about 860 feet, between Quincy and Sherman Streets. Unfortunately, proper attention was not paid to the condition of the ground, which is a sandy loam, and was very wet at the time of the laying down of the pipes. It resulted that, on account both of unequal settlement and of the non-resistance of the soil on the sides of the pipes, too great pressure was exerted by the soil upon the sewer, and after only a few years of service it was discovered that the pipes were cracked in a very bad way, and that several joints were far from being tight.

In 1914 the matter received serious consideration, and a resolution was passed upon by the Board of Commissioners, ordering either the repairing of the sewer or, if the cost of such repairs was to exceed a certain amount, the construction of an altogether new sewer. On December 2nd a careful investigation of the sewer condition was made by City Engineer Colin R. Wise and others. The sewer was found cracked for over half of its length, and at some places the settlement had been so great that the pipes had a nearly oval shape. Several joints, too, were in so bad a condition that the end of one pipe was fully three inches from the bottom of the bell of the next one. It was decided to repair the sewer, and the following plan was adopted:


4'-6"
3'-0"
2" Spruce Sheeting
Line of Cutting Off Before Back Filling
8"x6"x3'-6" Spruce 5'-0" Apart
3'-6"
Av. 12'-0"
6"x8" Spruce Rangers
8"x6"x3'-6" Spruce 5'-0" Apart
3'-10"
2'-0"
27"
15"
2"
Broken 30" Pipe

Method of repairing sewer.

The 30-inch vitrified pipe, wherever cracked, is to be embedded in at least 9 inches of good concrete, and the trench must be strongly timbered, as shown by the accompanying sketch, so as to prevent any settlement, either during the repairs or after.

The concrete reinforcement of the vitrified pipe is to be allowed to set properly, and then the timbering must be cut three feet below the surface of the street, leaving the rest in place.

The concrete specified is to be made of one part of good Portland cement, three parts of clean, well graded sand, and six parts of broken stone, all numbers of parts referring to measures of volume.

The specifications require a thoroughly compact back filling, so as to permit the sheet asphalt pavement to be hurried along in the early part of this spring on that part of Hope Avenue, without any danger of settlement taking place afterwards.

In the place where the original settlement has been so bad as to deform entirely the shape of the sewer, it was decided to remove the broken sections, and to substitute for them new 30-inch double strength vitrified sewer pipe.

During the inspection trip through the sewer, on December 2nd, 1914, a very bad smell was noticed in the pipes, and upon close examination, it appeared that an overflow pipe of the sanitary sewer was connected with the storm water sewer—a construction which does not reflect advantageously on the designer of this old sewer.

The work of repairs to the storm water sewer amounts to about 470 lin. ft. of concrete reinforcement, 50 lin. ft. of new 30-inch pipe, 20 joints to be recemented from the inside, and two bottoms of manholes to be reconstructed. The contract was awarded for the following prices: Concrete reinforcement, $2.65 per lin. ft.; new 30-inch sewer pipe, $3.40 per lin. ft.; cementing joints, 30 cents per joint, and manholes, $3.00 per bottom. The total approximate cost is $1,421.50, and the work is to be completed in thirty-five working days.

Interest charges have hurried sky scraper construction so much that recent buildings in Chicago have been completed within a year, whereas a few years ago, and in other cities now, from 1½ to 2 years are considered the necessary interval. The Kaiserhof was finished in eight months and the New Morrison Hotel in twelve months, said Charles E. Fox at the convention of the American Concrete Institute. Steel specifications call for the erection of two storeys per week, and on the New Morrison the contractors sometimes erected two storeys per day. Three months' time is saved by working from the ground level up and down, rather than waiting until the deep excavations are entirely completed before starting the superstructure. In the hotel noted above the excavation went down 52 ft. below sidewalk grades and was completed during the same week that the roof was finished. Owing to the great depth of the basements it is found necessary to utilize steel-column framework, rising from the tops of the caissons, in the cross-bracing system to support the retaining walls. The weight of the superstructure is a material factor in maintaining the stiffness of the substructure bracing.

Statistics on fatal accidents at railroad crossings are contained in the report of the National Highways Protective Society for 1914. According to the figures given there, the number of persons killed in railroad crossing accidents during 1914 was 199, as compared with 124 for 1913 and 107 for 1912. Of those killed in 1914, 133 were pedestrians, 35 were occupants of motor cars, and 31 were occupants of wagons.

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* Assistant City Engineer, Passaic, N. J., writing in The Municipal Journal.

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The Road to Berlin

It is a long road that has no turning, and the road upon which we are all embarked—the road to Berlin—is no exception to the principle. It was fine to note the spirit of optimism and confidence shown at the opening session of the International Good Roads Congress in Toronto last week—a report of which is published in this issue. In moving a resolution appreciative of the action of Major T. L. Kennedy, of Dixie, Ont., in going on active service, Mr. N. Vermilyea, of Belleville, voiced the right spirit when he said: "To-day there is just one road for us all, and that is the road that leads to Berlin. Just as surely as we shall work out a highway scheme for the province, so surely shall we finish the job before us and go the full distance of the road to the German capital."

Mr. Vermilyea was followed by Mr. George W. Tillson, of Brooklyn, N.Y., President of the American Road Builders' Association, who said that the interest in road work taken by people in the United States was only exceeded by their keen desire to see Great Britain well on the road to Berlin.

We want all the optimism we can bring to bear, and while we do not need encouragement from outside sources we appreciate it when it comes. In every sphere of endeavour it should be our policy to combine activity and aggressiveness in our own particular business with outspoken, ungrudging confidence in the power of the Allies to wreck the German war machine. Such confidence helps.

Russian Government Places $30,000,000 Order With Canadian Concern

The Canadian Car & Foundry Company, Montreal, have received from the Russian Government an order for two million shells, which represents an expenditure of no less than thirty million dollars. The deal has been closed, and all the necessary information and data have been received. The Canadian Car & Foundry Company are sending invitations to forty or fifty Canadian manufacturers asking for prices on parts of the shells. The time limit on the order is understood to be in the neighborhood of ten or eleven months. Operations will be commenced at once, and all workshops and other plants equipped to handle the business will be given a chance to operate to capacity. It is interesting to hear that in regard to the transportation of the shells, efforts are being made to have a steamship line subsidized by the Government to operate direct to Russia. Business as usual—only more of it!

An official memorandum regarding war orders states that at least ninety-five million dollars' worth of war material and equipment has been ordered by the allies from Canada, and that this expenditure does not include that incurred on behalf of the Canadian contingents, which exceeds twenty-five millions. Seventy two Canadian companies have been given orders for machining shrapnel shells, and 67 are engaged in making the various parts required. The orders placed in the United States amount to more than a billion dollars.

Writing in the American Journal of Archaeology, E. B. Van Deman takes up the old subject of the antiquity of concrete. He says: "In no period was concrete used to any extent without facing except in foundations and other visible parts of buildings. Roughly at the beginning of the Christian era it reached the position of dominant material (or mode) of construction. Before 100 B. C. some monumental structures containing concrete were erected, and from that time on the material was increasingly used, including exterior facings in concrete. The dome of the Pantheon, erected 123 A. D., is still regarded as the finest example of ancient concrete work extant. It is 142 ft. in diameter, with an opening of 30 ft. diameter at the top, and without showing appreciable injury has withstood the destructive influences of the weather for nearly two thousand years.

* * *

A recent lecture in London, Eng., by Mr. Banister Fletcher, dealt with the construction and equipment of the great Roman Thermae, which revealed that love of luxury which gradually gnawed at the vitals of Roman power and prowess.

These gigantic thermal establishments show us those old Romans as past masters in matters of water supply, central heating, and complicated planning of vast establishments designed to minister to the pleasure needs of a population that Emperors sought to placate. The old spirit which had made Rome the mistress of the world was flickering out, and men's minds were turned from arms and war in distant provinces to the pursuit of pleasure and personal indulgence, and these magnificent and monumental buildings were the last word in luxurious living, providing, as they did, not only for bathing and its attendant services, but also for amusements, exercise, lounging, gossip, and even lecturing, and in these marble halls and colonnades the gilded youth of Rome chatted over the news from the front and criticized the Government at home.

Buildings designed to meet such complicated requirements involved a fresh development in architectural planning, and they could only be carried out by using slaves for labor and concrete for material. "The Thermae of Caracalla," said Mr. Fletcher, "was the first great Roman building which resembled the complicated character of a modern architectural plan." This great block, with its central tepidarium flanked by the frigidarium, calidarium, and countless chambers and corridors, was vaster in extent than Westminster Palace, including the Great Hall itself. Similar baths were erected throughout the Roman Empire, whether at Pompeii, in Italy; Timgad, in Africa; or Bath, in Britain.

Stone screenings as fine aggregates for concrete are not favored by the New York State Highway Department. As a result of some field tests of concrete in which all the fine aggregate was stone screenings, it was decided that the only allowable use of such screenings should be in conjunction with a much larger percentage of sand. It was found that a proper proportion of screenings from a hard stone will improve a fine-grained sand; but the high cost of proper inspection and mixing makes the use of such a mixture prohibitive, except where a good sand is very expensive. Laboratory tests of screenings as aggregate showed up much better than the above field tests.

Build Now—For Patriotism and Profit

IF ever there was a time when a sound constructive policy could be put into effect with patriotism and profit, it is NOW. Business is depressed, labor in consequence is plentiful, competition among contractors was never keener, materials can be bought at rock bottom prices, and speculative values on building sites no longer obtain.

Such favorable circumstances cannot last for ever. The rejuvenation of spring must have effect, and with the success that has attended the allied arms of late, and with the increasing certainty of a reasonably early termination of the War, a marked revival in trade cannot be far distant. When that revival comes, prices will start to climb back to their old levels, and the opportunity of the present will gradually fade away.

Canada has not been doing too badly—in fact, the volume of business she has transacted during the last few months has been highly encouraging. What we are losing in the swings is being returned to us three-fold in the roundabouts. Evidence of this is to be found in the fact that the war contracts placed with Canada so far have represented an expenditure of over a hundred million dollars. This is Canada's opportunity to make a name for herself industrially, and she is rising to the occasion.

A great deal of new business is coming to us, and much of it is of a specialized kind, requiring new plant and equipment. On every hand we find the Canadian manufacturer reaching out for new business. A universal effort is being made to replace German and Austrian imports by Canadian-made goods. All this spells EXPANSION, and the man with the money to build and an eye to the future will act accordingly.

During the last few weeks the announcement of a number of particularly noteworthy constructional enterprises has been made in the Contracts Department of this journal. The promoters of these projects may be called "lucky" a year or two from now, but they know what they are doing: they are taking the tide at the flood—knowing that the opportunity to do so comes only once in the average man's lifetime.

When the war is over, millions will be released from the obligations of war, and Canada, the last great country of the West, cannot fail to get her share.

It is as clear as possible that the sign of Expansion is in the horizon. Those who are too shortsighted to see it will remain in the background with the olla podrida of pessimistic humanity which never says a foolish thing nor ever does a wise one.

Now is the appointed time for the construcor. He can never apply his money to a better purpose than building enterprise in Canada to-day; he can never build with greater profit to himself, to his fellow man, and to his country.

Canada and the United States Join in Great Road Convention at Toronto

Staff Report of the Second Canadian and International Good Roads Convention and Exhibition (March 22 to 26), at Which Every Province in the Dominion and Nearly Every State in the Union Were Represented

THE Second Canadian and International Good Roads Convention held last week in Toronto passes into history as the greatest and most representative gathering of the kind ever held in Canada. The meeting was held under the auspices of the Dominion Good Roads Association and the Ontario Good Roads Association. Every province in the Dominion was represented, while the proportion of the programme which fell to road experts from the United States is significant of the wide and influential scope of the movement.

At the opening session the delegates were welcomed by the Hon. J. S. Hendrie, Lieut.-Governor of Ontario, the Hon. Finlay Macdiarmid, Minister of Public Works for Ontario, and Mr. Thomas Church, the Mayor of Toronto. In the regrettable absence (through illness) of the President, Mr. W. A. McLean, Chief Engineer of Highways for Ontario, the chair was taken by Mr. U. H. Dandurand, of Montreal.

In the course of his remarks Mr. Church, who is President of the Union of Canadian Municipalities, made the interesting statement that he had received Government assurance that when the war was over there would be legislation providing not only for provincial roadways but for a system linking up the provinces of the whole Dominion.

The real work of the Convention commenced on Tuesday morning, with an address on road construction by Mr. George C. Diehl, Engineer of Erie County in the State of New York. Only brief reference is made in this report to the various papers presented at the Congress, as a number of the more important ones are published in this issue, and others will follow next week.

"Wearing Surfaces" was the title of a paper read by Mr. George W. Tillson, President of the American Road Builders' Association, Brooklyn, N. Y.

The afternoon session opened with an address by President Falconer, of the University of Toronto. Mr. Falconer said that civilization depended on intercommunication by which an interchange of views was made possible. There had been periods in the world's history when movements of population had taken place, usually from east to west. The present day had seen an even greater proportionate movement in Canada than in the United States. The communication between town and country in this day of large and crowded cities had become most important, and although the railways had done much to establish connections they were not sufficient to take care of all the movement.

Mr. S. L. Squire, Waterford, Ont., First Vice-President of the Ontario Good Roads Association, read a paper entitled "Finance." In substance Mr. Squire said that to tax the cost of roads on an equitable and popular basis was one of the chief problems of the good roads movement.

Mr. H. J. Bowman, County Clerk and Treasurer, Berlin, Ont., followed, and mentioned the possibility of its being necessary to levy a provincial tax for roads as had been done this year for war purposes.

Mr. U. H. Dandurand suggested that if no other claims were introduced, Montreal should be chosen as the place for the next convention, and he extended a very hearty invitation to that city.

A paper on Road Laws was read by Mr. B. Michaud, Deputy Minister of Roads for Quebec. Mr. J. F. Beam, of Black Creek, Ont., spoke on the same lines. In the absence (through illness) of Mr. A. McGillivray, of Winnipeg, Chairman of the Manitoba Highways Commission, the Chairman called upon Mr. Leveque, the Member for Laval County, Quebec, who said that enough railways had been built, and that as the farmer had paid for these he should not be afraid of paying for good roads, which would be of more direct benefit to him.

Mr. B. Michaud, Deputy Minister of Roads for Quebec, the New President of the Road Congress.

A most interesting and practical paper entitled "Bridges and Culverts," was read by Mr. Lucius E. Allen, C.E., of Belleville, Ont. In the ensuing discussion Mr. Norman M. McLeod, of Toronto, drew special attention to the importance of the floors of the bridges, and said that creosoted wood block, chiefly on account of its lightness, was the ideal bridge flooring, unless other material was so readily available as to be very cheap. Mr. Frank Barber, C.E., of Toronto, spoke on the question of designing and making bridge approaches, and said that both the road approaches and the banks of the stream on both sides of the bridge should be attended to. Often boulders, stones and loose gravel were to be seen heaped up between the abutments of the bridge above water level. Mr. Barber said that in this case it was better to clean out the channel and keep the span narrow so that low water would wash both abutments. For approach fences he recommended concrete posts with gas pipe rails. These posts should rest on the old earth bed, or if the fill was too deep, blocks of wood should be placed on the bed high enough for the base of the posts to rest on. While most bridges were made 16 ft. wide, in which space it was possible for two average vehicles to pass, most drivers preferred not to pass on such a bridge, thus the extra width had been put in to no purpose. For light traffic, Mr. Barber recommended that a width of 14 ft. would be amply sufficient, while in the case of traffic which would seem likely to require that two vehicles should pass on the bridge, it should be made 18 ft. wide. The side slopes of approaches should not rise more than one in one and a half. Mr. Barber said that proper slopes seemed to be an exception in provincial highways. The probable reason for the steep slopes on fills had been, no doubt, the idea of economy, which usually turned out false. Easy slopes on approaches removed the necessity for fences when the fill was low. The slope at wing walls should be one in one and a half to avoid unnecessary length in these walls. Sodding on cuts and fills cost on the average nine cents per square yard, but by doing this, repairs had been rendered unnecessary. Wing walls retaining approach fills should conform to the slope of the fill. Splay wings were best set at an angle of thirty degrees to the face of the abutments. Straight wings should not be used for waterways on account of the possibility of water washing in behind the walls and undermining the fill. Sometimes U-shaped wings were best with arch bridges. Naturally, the higher the fill the longer the wings, but when the fill was very high, it was best not to attempt to retain it, but to build shore spans instead and let the fill take its natural slope.

The fourth session of the convention opened on the morning of Wednesday, March 24, with an address by Mr. R. A. Meeker, State Highway Engineer, Trenton, N.J., who spoke on the State roads of New Jersey, of which he has been in charge since 1900.

"Foundations" was the title of a paper read by Mr. J. Duchastel (City Engineer of Outremont, Que.), who emphasized the necessity of making foundations permanent. Surfaces took the wear and had to be renewed periodically. Foundations should be constructed so that the surface might be renewed time after time without the necessity of interfering with the foundations.

In dealing with the scientific construction of roads, under the heading of "Machinery," Mr. Fred E. Ellis, of Peabody, Mass., said that in the United States it had been proved that the use of machinery had resulted in a much higher grade of road than when manual labor was used, and that only the best results could be obtained when proper machinery was used and the employment of laborers reduced to a minimum. To construct the best roads it was necessary for the authorities to have an expert in charge—a man who would be able to select the type of machinery which would be most suitable for the class of highway that had to be constructed.

On Wednesday afternoon, Major W. W. Crosby, of Baltimore, Md., opened the session with an able address on "Dust Prevention"—reproduced elsewhere in this issue. Major Crosby, who has made a special study of this phase of road work, said that prevention by using proper materials in making roads was better than suppression by periodically treating after building. In answer to a question, Major Crosby said that cement and brick paved roads, while not producing a great deal of dust of themselves, did nothing to hold down any dust that might be brought on to their surfaces. Prof. A. T. Laing, of the Department of Applied Science, University of Toronto, discussed some of the points raised by Major Crosby.

Speaking on Road Maintenance, Mr. L. Henry, Chief Engineer for the Province of Quebec, said that since there was no such thing as an absolutely permanent road, the maintenance required as much work and thought as the first construction. Discussing this paper, Mr. Charles Talbot, Middlesex County Road Superintendent, London, Ont., directed the attention of the delegates to the fact that every paper read so far had dealt with the more advanced methods of road building. They had listened to papers on concrete roads—of which there were only fifty miles in Ontario—and on macadam roads—of which Ontario had about two thousand miles—but nothing had been said about the eighteen or nineteen thousand miles of gravel and ordinary roads throughout the province, which should be the first consideration. The more expensive the road, the more money must be provided for maintenance.

The fifth session closed with a paper on "Road Organization," by Mr. George H. Henry, M.P.P., Todmorden, Ont.

Where "None was for a Party but All were for the State"

The sessions held on Thursday, March 25, were notable for interesting addresses on "Road Location," by Mr. C. R. Wheelock, County Engineer of Peel, and on "Gravel and Stone Roads," by Mr. Charles Talbot, Middlesex County Road Superintendent, London, Ont. The gist of Mr. Wheelock's observations was that roads in Canada were located largely to suit property lines, rather than for foundations and grades, thereby increasing the cost and difficulty of construction. The influence of location, the methods of deviating existing roads and of straightening or otherwise improving the location, were matters for consideration. Among those who took part in the discussion of Mr. Wheelock's paper was Mr. N. W. Rowell (Leader of the Opposition in the Ontario House), who told the delegates that they should take particular pains to educate the members of the Legislature, and expressed gratification at the fact that all were united on the importance of the Good Roads movement—without respect to party. When the Liberal party was in power the present road work in the province was started. Now that the Conservative party had the reins the work was continuing.

Mr. J. F. Whitson, Superintendent of Colonization Roads in Northern Ontario, expressed approval of Mr. Rowell's assurance. The speaker pointed out that owing to lack of gravel in the clay belt of Northern Ontario the roads in that district had to be made up without stone. The location of a road was all-important. In the old days, in the north, roads were located in the low lands and the swamps for winter travel, and on the high ridges for summer traffic, thus constituting the "low roads" and the "high roads." Now that modern methods had been brought to bear many of these old roads had been abandoned.

Mr. Charles Talbot emphasized the point that for many years the greater mileage of surfaced roads in Canada must continue to be made with gravel and broken stone. It was most desirable for all concerned with road work to be well posted in the details necessary to good results in construction and maintenance. It was useless to spend money on building roads and then let them go year after year without repair.

In the absence of Mr. H. T. Routly, of Huntingdon, Que., an abbreviated version of his paper "Good Roads and the Contractor" was read for him. It is proposed to publish this paper in full in an early issue of The Contract Record.

A paper on "Town Planning," read at the Thursday afternoon session by Mr. Thomas Adams, town planning adviser to the Commission of Conservation, Ottawa, is reproduced in extenso in this issue.

An instructive address on "Traffic" was given by Col. W. H. Sohier, of Boston, Chairman of the Massachusetts State Highway Commission, who emphasized the need for building roads with careful regard to traffic conditions. The manner in which such conditions change, the need for regulating traffic, of limiting roads and of providing for the speed and width of tires was discussed.

A paper on "Brick Roads and Streets," prepared by Mr. E. A. James, of Toronto, outlined the extent of the use of brick in the construction of town and city streets, and showed its adaptation to country roads.

A particularly illuminating and instructive address on "Bituminous Construction" was given at the opening session on Friday, March 26, by Mr. J. Pearson, President of the Constructing and Paving Company, of Toronto. Mr. Pearson's paper will be published in full in a later issue of The Contract Record. It shows how the use of tar and asphalt in road construction has developed on standard lines, and covers many practical features of the work.

"Concrete Roads and Streets" was the topic of a paper presented by Mr. H. S. Van Scoyoc, Chief Engineer of the Toronto-Hamilton Highway Commission. The speaker showed how the use of concrete for road surfaces, while a comparatively new departure, was attracting the attention of highway engineers. A careful perusal of this paper, which is published in this issue, will disclose many facts on which all who are interested in road improvement should be informed.

The Friday morning session, which really marked the close of the technical part of the Convention's programme, was terminated by a paper, "Creosoted Wood Blocks," given by Mr. A. F. Macallum, City Engineer of Hamilton. This paper will be found on another page.

At a business session held on the closing day Mr. B. Michaud, Deputy Minister of Roads for the Province of Quebec, was elected President. The meeting place of the Congress for next year was not chosen. Other officers elected were: Honorary Presidents, Messrs. W. A. McLean and U. H. Randurand; Secretary-Treasurer, G. A. McNamee, Montreal; Educational Committee—Messrs. W. A. McLean, O. Hezzlewood, J. Duchastel, R. S. Henderson, P. J. Shore, Lieut.-Col. Ponton, J. A. Sanderson, W. Pillow and G. A McNamee.

A Round of the Exhibition

Albion Motor Car Company of Canada, Toronto and Montreal.—This firm showed a tandem road roller made by Barford & Perkins, Peterborough, England. This roller is driven by a gasoline engine and has a tank for water ballast. The engine is of the 2-cylinder automobile type.

Asphalt & Supply Company, Limited, Montreal.—This company had an extensive exhibit of Mexican paving asphalt and road oils under the supervision of Mr. W. A. Morris, engineer, and Mr. Albert d'Estiambre. Samples of finished paving made by both the penetration and mixing methods showed just how the oil or bituminous material binds the stone aggregate. A small size flapper machine for applying heavy oil or heavy penetration material attracted particular attention. The flapping action of this machine forces the binder into the macadam. This exhibit covered every kind of bituminous road treatment. A booklet, "Fluxphalte," distributed by the company, gives some idea of the popularity of their production, especially their eighty per cent. oil, the trade name of which forms the title of the book.

Aug. Brunette, Montreal.—Mr. Delaurier, Past President of the Montreal Builders' Exchange, had charge of the demonstration of kerosene burners for the quick heating of lead, etc. The chief claim of this burner is its safety as compared with the gasoline stoves and torches. A torch attached by a hose to the reservoir can be used in any position, as for melting lead pipe joints. A No. 5 heater of this type will melt 800 lbs. of lead an hour.

Baines & Peckover, Toronto.—Several kinds of expanded metal reinforcement suited for use in the construction of concrete road foundations were shown by this firm.

Canadian Clay Products Bureau, Mimico.—In this booth The Ontario Sewer Pipe Company, The Hamilton & Toronto Sewer Pipe Company, and The Dominion Sewer Pipe Company exhibited samples of their clay sewer pipe. The good roads feature in the booth was a culvert built of brick with a clay tile drain.

Canadian Fairbanks-Morse Company, Limited, Toronto.—A patriotic note was struck by the exhibit of the Fairbanks-Morse Company, for included in their samples of steel wheelbarrows and similar tools were several shrapnel shells, such as they have been manufacturing at their West Toronto factory. One of the shells had a quarter section removed throughout its length, showing how the shell is filled with bullets, and showing also the timing device. This company had one road roller driven by a two-cylinder engine using kerosene.

Canadian Ingot Iron & Culvert Company, Limited, Guelph, Ont.—This firm showed several sections of galvanized corrugated cylinders suitable for use in road culverts.

Creosoted Block Paving Company, Limited, Toronto.—Creosoted lug blocks and plain blocks were featured in this exhibit. A section of road was shown with five-inch concrete base, sand-cement cushion and joints filled with pitch. This wood block is favored for bridge flooring on account of its lightness. A square foot weighs only thirty pounds, and is usually laid on a three-inch plank sub-floor, the planks also being creosoted.

Dunn Wire Cut Lug Brick Company, Conneaut, Ohio.—Samples of road brick manufactured by the twenty-six companies licensed by the Dunn Wire-Cut-Lug Brick Company were the outstanding feature of this exhibit, there being two brick from each manufacturer. A mounted slab of what is known as the "Hillside Brick," which is used on heavy grades, was also shown. This brick is grooved across the wearing surface to afford a foothold for horses. Some of it has been laid on Christie Street, Toronto. Mr. Frank B. Dunn, General Manager; Mr. William E. Perkins, Chief Engineer, and Mr. Frank T. Townsend, Assistant Engineer, were in charge of the booth.

J. I. Case Thershing Machine Company, Toronto.—This company showed a good line of heavy road-making machinery, including a crusher combined with elevator and rotary screen on a portable delivery bin. Rock is fed to the crusher and carried up by the bucket elevator to the rotary screen, which distributes it into the bins. The whole set is portable. In addition to this set they had one heavy steam roller and a road grader, or road machine, with scraper set diagonally across the machine.

Lecky & Collis, Napanee and Toronto.—Some interesting small scale machine models, including an Austin cube mixer, a drag line grader, a crusher and a clam shell were demonstrated by this firm, who handle several types of concrete and excavating machinery.

Ontario Rock Company, Toronto and Havelock, Ont.—Trap rock, which is greatly favored for road building on account of its comparative toughness as compared with the brittleness of harder rocks, formed the exhibit of the Ontario Rock Company, who quarry this rock at Havelock. Six sizes were shown. The finest grade is claimed to have an even greater cementing power than limestone, which has generally been considered the best binder.

Paterson Manufacturing Company, Limited, Toronto.—Three grades of Tarvia—"Tarvia-A," "Tarvia-B" and "Tarvia-X"— were shown at this booth. Tarvia is a coal tar preparation specially refined for use on roads. "Tarvia-B" is a thin preparation designed for application to road surfaces as the best dust-layer and road-preservative. "Tarvia-X" is a heavy, almost solid bitumen used as a bituminous binder in road construction. "Tarvia-A" lies between the other two in consistency and was the original Tarvia manufactured.

Philip Carey Company, Toronto.—Mr. H. E. Rowell, the Canadian Manager of this company, had charge of the exhibit of "Elastite," a prepared filler for expansion joints. The joint is composed of two layers of felt saturated with asphalt between which is placed a heavy body of asphaltic compound. This filler is used to take care of expansion in brick, wood block, granite block and concrete roads, and in any other form of construction that requires an expansion joint. The joint is put in position when the street is laid, so that it is not necessary to use wood spacing strips and boring equipment for pitch fillers.

Sawyer-Massey Company, Limited., Hamilton, Ont.—A very complete line of road-making machinery was included in the exhibit of the Sawyer-Massey Company, of Hamilton, who had two steam rollers, besides several large capacity drag and wheeled scrapers. One heavy rock crusher was belted up to an elevator and rotary screen, and driven by a gasoline engine, thus showing the actual operations by which rock may be crushed and sorted right on the job. The Sawyer-Massey one and two-horse scrapers with or without wheels are well adapted for grading roads where much material has to be removed.

Trussed Concrete Steel Company of Canada, Limited, Walkerville, Ont.—This firm exhibited a complete line of reinforcing materials for concrete roads. They featured Kahn-Armor Plates, a steel bevelled edge channel section for protecting expansion joints; Kahn curb bars for protecting the edges of concrete curbs; Trus-Con steel side forms; and rib metal reinforcement for concrete roads and sewer pipe. A new installing device used in placing Kahn-Armor plates is of special interest to any one having to do with road construction.

United Brick Company, Limited, Greensburg, Pa.—Exhibiting jointly with The Dunn Wire-Cut-Lug Brick Company, The United Brick Company, one of their licensees, showed an entire section of road paved with their brick. The United Brick Company has a contract for supplying wire-

The Alfred Rogers booth at the Road Congress Exhibition. The artistic and refreshing character of this booth enhanced the pleasure of "talking cement" to the representatives of this enterprising firm.

cut-lug brick to the city of Toronto. Mr. Frank B. Goodman, Toronto, is the Canadian representative. The section of "Hillside Brick" shown by the Dunn Company came from the plant of the United Brick Company, at Conneaut, O.

Woodstock Concrete Machinery Company, Limited, Woodstock, Ont.—Stone crushing and concrete machinery especially suited for road work, both in surfacing and in drainage, was shown by this company. A feature was a Besser power tamp cement tile machine which was under power, although not actually manufacturing tile. The machine is automatic in action, the aggregate being carried up in a bucket elevator and fed into the form. As is implied by the name, the cement is tamped by the machine and all that is necessary to do is to place the form in the machine and remove it when filled.

Rocmac Roads, Limited, Toronto.—In this exhibit a model road constructed with Rocmac Mineral Binder displayed the type of surface obtained and the different phases of construction. The claim advanced for Rocmac roads is that they are odorless and clean, that they will not crack, and that they are not affected by variations of temperature. Waterproof and frostproof, these roads are specially recommended for steep grades, and are said to have three desiderata—namely, low first cost, long life, and low cost in maintenance. Shipment is made in barrels or tank cars by the companies manufacturing this product.

Papers[*] Presented at the Second International Good Roads Congress, Toronto, March 22-26, 1915.

Wearing Surfaces

By Geo. W. Tillson, Consulting Engineer to the Borough of Brooklyn, N. Y., and President of the American Road Builders' Association.

THE question of improved roads first became important when transportation of commodities and passengers by wheeled vehicles came into vogue. This was in comparatively recent times, as the world's history goes, for as late as one hundred years after the region of Queen Elizabeth regular pack trains for the transportation of goods were operated in England, and even at that time wheeled vehicles for passengers were very little used. Writers tell us that in the seventeenth century the nobles, in travelling from their homes to London in private carriages, were often robbed by highwaymen, so frequently indeed that a highwayman, when convicted, was punished with death. It is also stated that the bad condiion of the roads aided the highwaymen very materially in making their hold-ups.

Ever since that time there has been much discussion regarding road construction, but it was not until 1764, when Mr. Tresaguet, in France, began to build broken stone roads of somewhat the same character as are now well known in America by the name of macadam, that much improvement was noted; and it was about sixty years after this that systematic road-building was begun in England, under the direction of Telford and Macadam, from which latter name has come the term in general use of macadam broken stone roads.

It would seem, too, that road construction in those days received more attention than pavement construction in cities, as it is said that an English engineer, in 1826, publicly remarked that however "true it may be that an observant traveller cannot fail of being struck with admiration at the excellence of the turnpikes and other roads throughout this country, he must at the same time be very much surprised at the badness of the carriage pavements, even of the principal streets of the metropolis."

The importance of road building in this country has been known for many years, but it did not receive much attention until about 1895, when the advent of the bicycle and its great popularity for a time made necessary the construction of improved roads if the bicycle were to be used to its best advantage.

When the use of the bicycle began to wane, the development of the automobile caused the subject to be taken up anew, and with increased vigor. The people using the automobile were much more influential and wealthy than those using the bicycle, and the result has been that a wonderful good-roads movement has been extended all over the country. It has grown to such an extent that in the State of New York alone during the last six or eight years issues of bonds to the amount of $100,000,000 have been authorized, and the greater part of this amount has been spent up to date.

Mr. J. C. Pennybacker, Chief of Road Economics, United States office of Public Roads, states that 16,000 miles of surfaced roads were constructed in the United States during 1913, and 18,000 miles during 1914, or a total of 34,000 miles in the brief period of two years. He estimates that the total outlay for 1914 for good roads will be $225,000,000, while in 1904 the total expenditure in all states slightly exceeded $79,000,000. This $225,000,000 represents an expenditure of $2.25 per capita for the entire United States, being about $20,000,000 for New York State alone for one year.

These figures are enormous, and one has to wonder if the work can be kept up, and also if, with this enormous amount of road building, sufficient provision, both in organization and in money, will be provided for proper maintenance.

KINDS OF ROADS

Earth Roads.—The cheapest form of road, of course, is the ordinary graded road, without any attempt to surface with any foreign material. Although this cannot be considered an improved road, still with proper attention to it results can be obtained that seem remarkable when compared with an earth road that receives no care at all. By the use of road drags and a little attention during bad weather, earth roads can be kept in fairly good condition for ordinary traffic.

Sand-Clay Roads.—These roads are made either by the application of clay to the ordinary sand surface or the application of sand to a clay surface, according to the original condition of the road to be improved. In proportioning sand and clay in this method of construction it must be understood that the clay acts practically as does cement in cement mortar, and consequently an amount of clay sufficient to fill the voids only should be used. This is more important than in the case of mortar, because if too large an amount of clay is used it will allow the particles of sand to move too freely, while if the amount is too small the particles of sand will not be bound together.

It must be understood, too, in this general treatment, that the quantity of sand to be used depends upon the character of both the sand and clay, a clean, sharp sand requiring more clay than one which has a certain amount of loam, and, too, the quality of the clay is an important factor, whether it is pure or whether it has an admixture of sand.

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[*] Or extensive abstracts thereof.

When a clay road is to be treated, the surface should be brought approximately to the form that is desired and loosened up; when the sand should be spread over the surface in sufficient quantities and thoroughly mixed. The surface should then be smoothed off and compacted with a light roller or road drag.

When the original soil is sand, the road is levelled off and the clay spread upon it to the required width and thoroughly mixed with the sand, when the roadbed is shaped up, and, if necessary, more sand applied. The surface is then smoothed and compacted as for the clay subsoil.

Gravel Roads.—Very satisfactory and fairly durable roads can be made with gravel, the exact method of construction depending upon the quality of the gravel itself, but, in the main, it is spread over the road to such a depth as to give proper thickness when completed and then rolled until it becomes hard and firm. Whether it will require any filling or binding in order to make the surface hard and compact depends upon the quality of the gravel. It can be said, however, that the softer the gravel, the more easily it will be compacted, but, for the same reason, it is less durable under traffic. These roads are often used in parks, and even on State roads where the traffic is light and where a permanent material is expensive. It is difficult to give an estimate of their cost, as this depends entirely upon the distances the gravel must be brought and its first cost. An estimate of 50 or 60 cents per square yard would probably be not far from correct for a gravel road 6 inches deep.

Waterbound Macadam.—This is the well-known broken stone road surface, which is made up of different layers of broken stone, the surface layer being about 3 inches thick and formed of stone that will pass through a 2-inch ring, the character of the stone depending a great deal, as in gravel, upon its binding easily. As a rule, limestones are of such a character that sometimes no rolling is required to obtain a smooth and hard surface, while trap rock, on the contrary, must have the interstices filled with fine material in order to get the stone sufficiently bound together. Waterbound macadam was laid in New York State in 1914 at a cost of 30 to 40 cents per square yard for a wearing surface 3 inches thick.

Bituminous Roads.—When the automobile, with its pneumatic tires, came into use, it was found that it presented an entirely different problem from the old horse-drawn vehicle with its steel tires. The former caused the macadam to disintegrate and ravel, while the latter had a tendency to compact it in a manner somewhat similar to steam rollers. This fact was recognized first in Europe, because the automobile was used there to a considerable extent previous to its use in America, and different methods of treatment were instituted to overcome the bad effect. The first method was to spray the surface with tar, and after many experiments, schemes were worked out that were fairly satisfactory. This method has been employed to quite an extent in America, but, with surface treatments, asphaltic oils are generally used, as they are cheaper and, some engineers think, better. The volatile parts of these oils evaporate upon exposure, leaving an asphaltic carpet over the surface which is much like an asphalt in its general appearance.

In Brooklyn, New York, nearly all of the park roads are of gravel, and a great portion of them have been treated as follows: Heavy asphaltic oil is spread on the surface at the rate of 7/10 of a gallon per square yard; the ruts and holes in the road are all repaired previous to the application of the oil. The oil is applied by gravity distributors, it being taken from tank cars, which are heated to a temperature of about 200 degrees F. before being unloaded. The oil is maintained in the distributor at this temperature and applied to the roadway surface. After the oil has been applied, a coating of coarse sand is spread at such a rate that one square yard of sand covers 53 square yards of surface. The roadway is closed to traffic for twenty-four hours after the spreading of the sand.

This process has been in use for two or three years and has given good results. It must be remembered, of course, that on the park roads no heavy vehicles are allowed, and it is undoubtedly true that with heavy steel-tired vehicles this treatment would not be satisfactory. Some trouble, even with the atuomobile traffic, occurs, in the shape of creeping and bunching of the surface, but the bunches are cut out and easily repaired.

The cost of the asphaltic oil delivered in cars is 6 cts. per gallon; the cost of sand alongside the road, $1.35 per cubic yard; and the cost of the complete treatment, including labor and materials, but not including overhead charges, has averaged 8 cts. per square yard for three years.

Another method of building bituminous roads is what is known as the penetration method, when, after the stone is spread upon the road, the upper surface is sprinkled with the bituminous material, whether tar or asphalt, and then rolled and completed with certain surface treatments. In New York State during the past year this treatment has cost from 50 to 60 cents per square yard for a wearing surface 2 inches thick.

In Massachusetts, by the penetration method, using 2¼ gallons per square yard of Bermudez asphalt, 2 inches thick, the cost has been 66 to 80 cents per square yard.

In Massachusetts, too, in 1914, there was used a surface composed of oil asphalt and gravel, using gallons of asphalt to the cubic yard of gravel, and spread so as to have a thickness of 2 inches after rolling, at a cost of 30 to 35 cents per square yard, while with old asphalt and sand, mixed and spread to a depth of 4 inches, after rolling, the cost was 54 to 60 cents per square yard. Using the penetration method with tar instead of asphalt, with 2¼ gallons per square yard of surface, 2 inches thick after rolling, the cost was 45 to 65 cents per square yard. It must be understood, of course, that these costs will vary, as in some cases gravel was used which cost 80 cents per cubic yard, while in others trap rock was used which cost $2.50 per ton, which is considerably more than the cost of gravel per cubic yard.

There are many other methods of using bituminous wearing surfaces. One of these is known as the Topeka mixture, as it was first used in Topeka, Kansas, and has been decided by the courts not to be an infringement on any patents. It is laid much as is sheet asphalt pavement, but with a larger aggregate. In 1912 over one hundred miles of roads were surfaced in the Borough of Queens, New York, with practically this kind of pavement. The specifications for the wearing surface for this work read as follows:

> "The finished pavement shall contain between 7 per cent. and 11 per cent. of bitumen soluble in carbon disulphide, depending upon its mesh composition, but in all cases sufficient asphalt cement shall be used to thoroughly coat all of the particles of the mineral aggregate.
>
> The mineral aggregate shall be proportioned as follows:
>
> "Mineral aggregate passing 200-mesh screen, from 5 to 11 per cent.
>
> "Mineral aggregate passing 40-mesh screen, from 18 to 30 per cent.
>
> "Mineral aggregate passing 10-mesh screen, from 25 to 55 per cent.
>
> "Mineral aggregate passing 4-mesh screen, from 8 to 22 per cent.
>
> "Mineral aggregate passing 2-mesh screen, less than 10 per cent.
>
> "Screens to be used in the order named."

Roads of this character were laid in New York State in 1914 by the State Highway Department, at a cost of 85 to 95 cents per square yard.

During 1914 some twenty-five or thirty miles of bituminous roads were built upon the Ashokan Reservoir of the new water supply system for New York City. The wearing course was formed of stone passing over a ½-inch screen and through a 1½-inch screen. By an adjustment of the jackets on the screens a sufficiently graduated stone was obtained to produce proper results. The broken stone was heated and mixed, in a machine similar to one used for sheet asphalt, with an asphaltic cement so that the resulting mixture should contain between 5 and 7½ per cent. by weight of bitumen. The mixure was spread upon the road and thoroughly rolled, when a seal coat of hot asphaltic cement was spread over the same, by a proper appliance, and then smoothed off with squeegees. The asphaltic cement was applied on the average at the rate of a little less than one gallon per square yard. Upon this squeegeed coat stone chips were placed, which were thoroughly rolled into the surface, any lack of chips being supplied by a second distribution. The wearing surface 2 inches thick cost about $1.01 per square yard, native stone being used.

It would be difficult, and perhaps unnecessary, to go into a detailed description of the many kinds of bituminous roads. Those herein described give a fair idea of what are in ordinary use.

Concrete Roads.—During the last five or six years quite a large amount of roads have been constructed having a wearing surface of cement concrete. It was thought at first that this would not give satisfactory results, as it was feared that the concrete would be so affected by the changes in temperature as to crack in cold weather or bulge in warm weather; also that it would be difficult to keep in repair.

Possibly the best and best known examples of concrete roads are located in Wayne County, Michigan, in the vicinity of Detroit. The writer had an opportunity of driving over these roads last summer, and he was very much surprised at their good condition. One in particular that was only 9 feet wide and half a mile long had been in use five years, and had cost during the entire five years but $26 for repairs. It is true that on this section the traffic was not great, but on another road, where the pavement had also been laid five years, under quite heavy traffic, the concrete was still in good condition. The cost of these pavements varied according to conditions, as practically all of the material had to be brought from out of the state, and the cost of even the water was great, as many of the roads extended into the country long distances from any watermains. The concrete for these roads was generally laid to a depth of about 6 inches, and the cost on the average was about $1.35 per square yard. On Michigan Avenue, however, the concrete was laid an average depth of 7 inches, mixed in the proportion of 1 part of cement, 1½ parts of sand, and 3 parts of gravel. In this particular case the cost of the concree was $1.47 per square yard.

In Massachusetts the cement concrete roads laid in 1914 were of an average depth of 7¼ inches, and cost from $1.40 to $1.55 per square yard, while in New York State, with a mixture of 1 part of cement, 1½ parts of sand and 3 parts of broken stone, averaging 6 inches in thickness, they cost $1.00 per square yard.

Concrete roads are sometimes covered with a thin coat of bitumen, the idea being to prevent the wear of the concrete and get a more resilient and a less noisy road. There has been some difficulty in making the bitumen adhere to the concrete. The practice of using the bitumen has not yet become general.

Brick Roads.—In the Central West, where paving brick is cheap and good, a great many brick roads have been laid. This is especially true of Ohio, and particularly around Cleveland. The writer in 1914 made an examination of many of these roads; while some of them showed some defects, probably due to lack of drainage, as a whole, they were in extremely good condition and must be a great boon to the farmers and other people living in the vicinity of Cleveland. It happened that the time the inspection was made was soon after a rain, when the clay of that country was in exceedingly wet and sticky condition, so that, when sometimes it became necessary to take an unimproved road to get from one brick road to another, the value and convenience of the brick roads were especially appreciated. These roads are expensive, as all of the material has to be transported for quite a distance, and much of it by horse-drawn or motor vehicles, as the roads are sometimes quite a distance from the railroads. The cost in Ohio for brick on concrete averaged $1.80 per square yard.

In New York State, in 1914, brick cost $1.55 per square yard.

It sometimes happens that, on account of the heavy traffic in the vicinity of cities, roads are constructed that are practically street pavements. In New York State, in the Eastern district, some asphalt block pavement was laid in 1914 at a cost of $1.40 per square yard.

It does not seem necessary or pertinent at this time to go into the merits or descriptions of the different kinds of road pavements, as that would mean an extended discussion.

TYPE OF ROAD TO BE SELECTED

Which one of the foregoing methods of improved road construction is to be used depends upon several conditions. The first of these is the ability of the county or state to pay for the work, and then there must be considered the amount of traffic which will use the road and its character. There is absolutely no use to plan a road, no matter how well adapted it is to conditions, if there are no funds to pay for it. With a limited amount of money the problem is to obtain results with that money, and in order to do this a complete investigation must be made of both the amount and character of traffic, because if the road is to be used by heavy vehicles, a different form of construction is required from what would be called for if the same tonnage were to be drawn over the road in smaller loads. It is possible that heavy loads may be so infrequent that they can be left out of consideration entirely, but if considered, upon their frequency will depend the treatment that should be given to the road.

If, however, funds are available to build the best road from an economic standpoint, the problem is somewhat different, as the matter of first cost is not so important as ultimate cost. In considering the ultimate cost, and assuming that the roads are built out of the proceeds of a bond issue, as they are in New York State, the expense is not the first cost, but the interest on the first cost, the cost of repairs, and the amount of money to be paid in each year for a sinking fund that will pay off the bonds when they become due. And in this connection it should be said that in any bond issue made for a road improvement, or for any other improvement, the term of years for which the bonds are issued should be equal to the life of the improvements as nearly as it can be estimated.

It is also necessary that the deciding official should understand fully the properites of each one of the different roads, so that he will know the ability of each one to sustain the traffic that he finds will be applied to it when constructed. He must understand, too, that a road when improved is liable to attract traffic, and that as a general rule the traffic will be much greater after a road is improved than before.

Having determined the type of road to be used, the exact material must be determined. This is an engineering proposition, and the availability of the material must govern the choice to a great extent. Trap rock, for instance, might work out as the most economical from a general standpoint, but might be prohibitive on account of the cost of transportation.

It often happens that a less valuable material will prove most economical, on account of its propinquity to the road, than a better material which must be transported some distance.

In this consideration it must be understood that there is a natural as well as a traffic life to road material, that is, gravel, stone, or brick will have a life according to the traffic, as they are not acted upon by atmospheric conditions, while, on the other hand, asphalt, coal tar, or other bitumens are acted upon directly by the atmosphere, and, even without traffic, have a certain life.

A careful study must be made as to all of these conditions, the first cost and the cost of repairs of the different kinds of wearing surfaces, together with their characteristics, as well as the availability of the different materials. With all these items before him, an official can determine pretty accurately which is the best surface to be used.

Creosoted Wood Block Pavements

By Andrew F. Macallum, City Engineer of Hamilton, Ont.

FOR fifty or sixty years before wood blocks were subject to treatment many pavements were laid in the United States and Canada for roadways and side walks. In this country mostly round cedar blocks were used, although the north sidewalk of King Street East, Toronto, was paved with a patented block known as the Nicholson pavement. These pavements, while satisfactory for a year or two, soon decayed and in a comparatively short time were removed. In most of these pavements little care was taken in laying or in the preparation of the foundation, which was generally plank laid upon the natural ground. After years of repeated failures, attention was directed to the use of preservatives, which in the first experiments made, consisted in placing thoroughly dried blocks in a bath of creosote heated to a temperature of about 210 deg. F., until about three pounds per cubic foot of creosote was absorbed. While these pavements were fairly successful, it was soon realized that the best results could not be secured by dipping the blocks, and the blocks were then treated with creosote under pressure, until they absorbed from ten to twelve pounds of oil per cubic foot. Such a pavement laid in Indianapolis, in 1898, gave such good results that city engineers began to appreciate the possibilities of treated wooden blocks, and better results were obtained.

On Tremont Street in Boston, a wood block pavement treated with creo-resinate process composed of one-half creosote oil and one-half resin was laid in 1898. The writer saw this pavement last October, and it was still in good condition after sixteen years of heavy traffic.

A small piece of similarly treated wood block was laid on the west side of Yonge Street, at Front Street, opposite the head office of the Bank of Montreal, in 1896, and was still in good condition when taken up for a new pavement about two years ago. The writer also examined such pavements in New York on Church and Warren Streets after they had been in use for nine years under the heaviest kind of traffic, and they were still in good condition. In the city of Hamilton probably more treated wood block pavements have been laid than in any other city in Canada, and the first pavements laid in 1909 are as good now as when they were laid, and although subjected to the heaviest traffic in that manufacturing city they have not to date cost a cent for maintenance.

These examples which I have mentioned are but a few of the numerous examples showing the permanence and suitability of this form of pavement for streets carrying heavy traffic. I may add that it has also been laid on residential streets where the residents assume its greater cost to asphalt for the added comfort through its quietness under traffic.

The wood principally used has been long-leaf (yellow) southern pine, which has been found from experience to give excellent results. Most specifications now, however, admit Norway pine, tamarac and white birch as a result of experimental pavements laid in Minneapolis, which showed the suitability of these woods. No doubt other species of wood make satisfactory pavements, but on account of the incomplete knowledge of their value city engineers prefer as a rule a wood that has been proved to be satisfactory.

The blocks are from three to four inches wide, and vary in depth from three to four and one-half inches, with a length of from five to ten inches. As or all timber specifications, the blocks should be sound, free from large or loose knots, shakes, worm holes and other similar defects. As to the proportion of sapwood and heartwood the present specifications are not very rigid, as experience has shown that treated blocks having both sapwood and heartwood do not vary in their wearing qualities.

The preservative used is a creosote oil having a specific gravity of from 1.08 to 1.14, containing a percentage of tar, free from carbon. Coal tar oils are used in preference to water gas creosote, as sufficient experiments have not yet been carried out with the water gas creosote to determine its relative value.

The writer has been corresponding with a number of city engineers with a view to obtaining opinions as to the most satisfactory amount of treatment required per cubic foot of block according to the experience of each city, and in replies from twenty cities in the United States has ascertained that six of these cities use 16 pounds, two use 18 pounds, and twelve use 20 pounds, depending to some extent on local conditions.

The base for wood block pavements should be of concrete from five to six inches deep, having the crown parallel to the finished crown on the blocks. An uneven or irregular base is detrimental to any pavement, as it is liable to cause a depression in the surface to hold water which the repeated impacts of waggon wheels is certain to increase, giving an uneven surface. Upon this concerte base is placed either a sand or mortar cushion. This cushion is usually one inch deep, and has its surface struck by templates to a surface parallel to the contour of the finished pavement. Where sand is used the sand is such that it will all pass through a quarter-inch screen, besides being clean. If a mortar cushion be used, some engineers use a proportion of one of cement to three of clean sand, to which sufficient water is added to insure the proper setting of the cement. Other engineers obtain good results by mixing and placing the cement and sand dry. This cushion is simply a means of securing a uniform surface for the blocks to rest upon and distribute the load. Alongside or between street car tracks, however, or on grades, sand cushions are apt to become uneven or flow caused by the vibration of the rails or by water getting in alongside the rails. Under these circumstances a concrete cushion should be used. Away from the car tracks it is a matter of opinion whether a sand or mortar cushion should be used. Sand gives a better cushioning effect, and the blocks do not have to be rolled so soon after laying as when a mortar cushion is used.

English and French practice does away with this cushion altogether, but the concrete base is finished off as smoothly as a concrete sidewalk and to the exact contour of the surface of the pavement. This extra care and workmanship obtain results that are excellent inasmuch as the finished surface of the blocks has no depressions and consequently the wheels cause no impacts.

In most cities it is not possible to lay the blocks shortly after coming out of the treating plant, and the hot sun and the wind during shipment and before laying is apt to check the blocks and cause oil to exude. The blocks should be piled closely when delivered on the street, and should be sprinkled before laying.

Generally the blocks are laid at right angles with the curbs, with an expansion joint at each curb of from three-quarters to an inch and a-half, according to the width of the pavement. Alongside the curbs three rows of block are laid parallel to the curbs, with the expansion joint next to the curb. Placing a longitudinal row of blocks with an expansion joint on each side is sometimes done, but is not good practice, as the single row of blocks between the joints will almost certainly rise up to about the level of the adjoining pavement as the joints close up. Cross expansion joints have been piled on a street for several months, but for fresh blocks properly treated they are not necessary on streets of heavy traffic. On streets of light traffic, however, there should be cross expansion joints placed from thirty to fifty feet apart, and having a width of about three-quarters of an inch. It is hardly necessary to say that the blocks should be laid with the grain vertical and having the joints in adjacent rows, broken by a lap of about two inches. The blocks should be laid neither too loose nor too tight, so that a block can be raised without disturbing the surrounding blocks, or one-eighth of an inch apart. After the pavement is laid it should be rolled thoroughly with a roller varying from three to five tons until a perfect surface has been secured with no depressions and the blocks firmly in place. There should be no difficulty in this, as the usual specification for blocks allows of a variation of but one-sixteenth of an inch in depth, so that if the foundation and cushion have been properly laid there is usually very little trouble about the depth of the blocks.

Alongside street railway tracks and about manholes special care should be taken in laying the blocks. It is usual in such cases to thicken the cushion so that the blocks shall be about one-quarter of an inch above the wearing surface of the rail or cover, and in a very short time the traffic will rub these blocks down to the level of the rail. Alongside rails to prevent water flowing down and under the blocks two methods are used: one is to place a specially cut creosoted plank under the rail to give a vertical surface against which the blocks are paved, and the second and usual method is to plaster the web with a rich mixture of sand and cement to the width of the rail head, the blocks being then laid against this. As with other pavements, it has been found that the girder lip rail is more satisfactory than the ordinary tee rail, unfortunately in use in most towns, for the permanence of the block on the inside or guage side of the rail. Incidentally it may be said that no pavement will be satisfactory alongside a street railway track if the rails lack sufficient weight, stiffness and foundation to prevent movement, especially at the joints.

There is a diversity of opinion among engineers as to the best joint filler to be used. The American Society of Municipal Improvements recommend a suitable bituminous filler when the blocks are laid upon a sand cushion, and a sand filler when laid on a mortar cushion. It is claimed for the bituminous filler, which fills the joints between the blocks to two-thirds their depth (the remaining depth being filled with sand) that it makes an absolutely waterproof pavement, and that it eliminates all expansion difficulties as each block is surrounded with an individual expansion joint. Unless the filler is a suitable asphaltic cement with a high melting point and low penetration there is apt to be a sticky surplus left on the surface. This filler will cost about 15 cents a square yard more than a sand filler.

A cement grout filler has been used, but unless the traffic can be kept off the pavement for at least ten days it is little superior to a sand filler.

The sand filler is generally used on streets of heavy traffic, the sand being coarse and sharp grained, and preferably heated before placing. The writer has used with excellent results a bituminous filler between and one-foot outside of street railway tracks, and a sand filler for streets. From results obtained he does not consider the extra expense in using bituminous filler justified for such streets unless the traffic be very light. On bridge floors it is better practice to use a bituminous filler with the blocks. After the pavement is rolled, sand to the depth of about half an inch is spread over the surface, and the street is thrown open to traffic.

This method of construction is satisfactory up to a three per cent. grade, beyond which the blocks are laid in a different manner. The crown should be as light as possible, being just sufficient to shed the water freely, which applies also to the pavements between street railway tracks.

When the grade of the street exceeds three per cent. a creosoted lath is inserted between each cross row of blocks to leave a space of about ⅜ of an inch. The lath fills this space practically for two-thirds of the depth of the block, and a bituminous filler is used. This method of laying the blocks forms a good foothold for horses, and is satisfactory up to and including a six per cent. grade.

One of the criticisms made of treated wood block pavements is that they are slippery, but in the writer's experience he has found that there is very little difference between these blocks and sheet asphalt pavements. When covered with a light frost or snow, or when the weather is foggy and damp, the pavement may become objectionably slippery.

In traffic observations made at Philadelphia, New York, and other cities, the evidence shown by the engineers at these places indicated that where treated wooden block and granite blocks were on parallel streets 70 per cent. of the teaming went on the wooden block.

On Stuart Street in the city of Hamilton, the writer laid treated wooden blocks between the street car rails and granite block between the outside rails and curbs, the pavement being on a five per cent. grade. Although most of the traffic was of a heavy teaming nature, it was found that fully 80 per cent. of the traffic, except on wet days, was on the wooden blocks

The first cost of wood block pavement is undoubtedly higher than that of most of the other paving materials. In the city of Hamilton, its average cost is from $2.85 to $3.00 per square yard, exclusive of grading. When its cheapness of maintenance, ease of cleaning, low tractive resistance and durability are taken into consideration this pavement, with its relatively high first cost, will compare favorably with and prove ultimately cheaper than one lower in first cost.

At a meeting of the Middle West Federated Boards of Trade held recently at Brandon, the Manitoba Provincial Government was heartily commended for its policy of road improvement for the province. Mr. C. E. Ivens, Chairman of the Manitoba Union of Municipalities, expressed particular gratification at the progress made under the 1914 Act, and spoke of the appreciation shown by the various municipalities. He anticipated great achievements during the next few years. At the close of the meeting a new President was elected, Mr. R. H. Scott, of Alexander, being the choice of the delegates.

The Provincial Government of Manitoba have voted the sum of $300,000 for aids to municipalities in road building and drainage work.

The Scientific Planning of Roads in Towns and Cities

By Thomas Adams, Town Planning Adviser to the Commission of Conservation Ottawa

THE importance of planning the roads and streets of our cities and towns has not been sufficiently appreciated in the past, and even now it is doubtful if it is regarded with the seriousness which it deserves. We are all agreed that on principle a city or town should be planned in advance, and that in the planning of a city or town it is important that its means of communication should have some relation to the means of communication of the surrounding rural areas. That means that we recognize the desirability of preparing a skeleton plan of roads for each province, on which the plan of each town and village can be based. The difficulty has not been in approving the principle, but in giving it practical effect. For one thing, those who have to administer the affairs of our municipalities, especially in this new country, are so much absorbed in the activities of the moment that it is difficult for them to give time to the work of preparing for the future. Hence, each generation goes on leaving to each successive generation the same problems and evils which they have had to deal with themselves, notwithstanding that they have learned the lesson of how to prevent the recurrence of these evils. Yet, when we come to analyze it nothing could be more absurd than our present haphazard and wasteful method, or rather want of method, of constructing roads and streets without regard to any general plan, without proper machinery to enable us to regulate width, direction and alignment according to scientific principles, and with insufficient regard to the designing of each unit in our road system.

The road system of a community is like the arterial system of the human body. The former provides for the means of circulation of towns and districts and connects up and provides access between the different parts. If not properly designed in advance, it leads to congestion. Regard should be paid to the need for main arteries, secondary arteries and the small branch arteries. Most of the large questions connected with municipal engineering have to be considered from this point of view. We design our sewerage system and our water supply system on a principle of having large mains, branch mains, and short connecting branches. What should we think of a system of sewering a town which had to conform to a regulation that all sewers had to be of one diameter? Yet it is on that absurd principle that we determine the width of our streets and roads to-day. For instance, Ontario has a by-law which prescribes that all roads shall be 66 feet in width, whether they be main arteries or short streets leading to a few private residences. It may be taken for granted that from two-thirds to three-fourths of our streets and roads in cities and towns are required for the purpose of local traffic only. If the 66-ft. width is determined, according to the needs of a main arterial road, then it follows that 75 per cent. of our roads are much too wide, and that in the absence of a plan we are causing the people of this country to bear the burden of unnecessary expense in making and maintaining streets.

As a matter of fact, what happens in practice is that our by-laws fix a width not according to scientific theory, nor yet on any practical basis, but simply because of the convenience of making a hard and fast rule in accordance with some custom. The 66 ft., which is the by-law width of Ontario, seems to have no other justification than the fact that it is the length of a chain. It is less by at least a third of the width that should be provided for main arteries and it is more than twice the width of what is necessary for short domestic streets. It is true that in the absence of proper planning schemes you must have a system of regulation fixing a general standard in these matters—that is the inevitable weakness of the by-law system—but my point is that it is fully as absurd to regulate the width of a street according to a fixed by-law standard as it would be to prescribe that all sewers and water-mains should be of the same capacity.

In Great Britain this point has been recognized for some years, but there difficulties are not so great as here. The standard width of streets in England is from 36 to 45 feet, with exceptions in some of the larger cities, where the width has to be 50 feet, and the result is that the public have to bear a somewhat heavy share of the cost of widening main arteries, although a great many old highways exist which are much wider than required by the by-laws, and form a sort of trunk system throughout the country.

The narrower widths of roads in Britain as compared with Canada is partly responsible for securing a higher standard of road construction and partly for enabling the middle and working classes to secure cheaper housing accommodation. In regard to the former matter we are apt to flatter ourselves in Canada that although our roads are not so good as the British roads, that is because this is a new country. We forget that the high standard applies to all new roads in Britain and not only to old highways, and that it is the new streets and roads which are being made to-day, rather than the old highways, which set the standard of modern efficiency in street making. When we remember this it is certainly a proper question to ask why suburban roads in Canada should not be as good as suburban roads in Britain. A good deal of time must pass, of course, before our rural highways can come up to the standard of those in the older countries, but that does not provide any excuse for the poor roads in many of our towns and the newly developed suburbs. One reason for the difference is due to a matter which I shall only refer to incidentally. In Britain, the burden of making new streets is placed on the shoulders of those who directly benefit from the subdivision of land for building purposes, and the roads have to be constructed according to the municipal standard before the land is fully used. In some cases buildings cannot be erected until the road is properly made. That is a matter which has a relation to the planning of roads, but it is a subject for separate consideration.

With regard to the fact that housing accommodation is cheaper where streets, other than main arteries, are narrower we have to remember that the cost of a site of a house consists of three things—(1) the actual site which it occupies, including curtilage, (2) the land given up for road access, and (3) the cost of local improvements, consisting of pavement, sidewalk, sewer, water-main, etc. In a country like Canada the cost of the bare land ought not to be a serious matter, and where it is forced up by speculation, as it now is, it ought to be controlled by legislation. The portion of the above cost, however, which seems to require most careful consideration on the part of engineers and administrators is that which is spent on local improvements. It is difficult to get at the figures, but I imagine they would be astounding, if we could obtain them, as to what proportion of the total cost per building site was in improvements and in maintenance alone.

In an English town the cost of the street, including the sewer, works out in an average case at $75 to $100 for a small workman's dwelling costing, say, $1,000 to construct. This would include concrete or stone slab sidewalks and a pavement with a finished surface of bituminous materials. The cost per lineal foot run for a first-class street 45 feet wide would be from $10 to $12.50. As the houses occupy only about 15 feet frontage, the cost per house is thus 15 x $5 = $75 to 15 x $6.25 = $93.75. It has been found in practice that by limiting the number of houses that can be erected on each acre to twelve, and giving them a frontage of 25 feet on a street 26 feet wide, dispensing with rear alleys, instead of 36 houses to the acre with a frontage of 15 feet on a road 45 feet wide, you get nearly three times the area round each house at no greater cost per house for road construction. The 26-foot road consisting of 18-ft. pavement and two 4-ft. sidewalks is regarded as adequate for purely domestic streets not required for through traffic, and the buildings have all to be set back 15 ft. from the boundary of the street, thus securing a minimum distance of 56 ft. between all buildings. This is for a purely working class district. Having regard to the importance of designing streets on which workmen's dwellings are erected so as to secure the utmost economy, it would be well for Canadian municipalities to consider whether narrower and better constructed domestic streets, and fewer streets with deeper building plots, accompanied by regulations limiting the density of buildings and the widths between the building lines, would not be better than the wilderness of bare dusty road and the crowded sub-divisions that are the result of our present policy. It may be open to question whether roads should in any circumstances be made as narrow as 26 ft., but as our by-law width in Ontario is 66 ft. as against 45 ft. in the instance I have given, the proportionate reduced width would be 38 feet to secure similar results.

Personally, I see no reason why such variations as the following should not be permitted, if the number of houses is restricted to the acre, if the narrower streets connect at both ends with thoroughfares, say, 40 ft. to 50 ft. wide, and if the streets are so situated that they are not likely to be required for through traffic:

(1) Streets not exceeding 350 ft. in length to be 24 ft. wide with 16 ft. carriage way.

(2) Streets not exceeding 700 ft. in length to be 28 ft. wide with 18 ft. carriage way.

(3) Streets not exceeding 1,500 ft. in length to be 32 ft. wide with 21 ft. carriage way.

It might be argued that even if we make our domestic streets too wide we usually ignore the question of construction altogether, and leave them to take care of themselves. I have been in more than one town in Canada where the streets have to be 60 feet wide, and where the only form of construction is the occasional levelling of the soil or the dumping down of cinders. The traffic for the most of the year on these streets follows one line, and the pavement area might for that purpose be 8 or 10 feet instead of 40 feet wide. The cost of maintenance in a case of that kind is, however, probably not less than it would be if the roads were properly constructed at the outset, and the loss to the community, indirectly, is a serious matter. There is the mud and the damp of the spring and autumn, and the disease-bearing dust of the summer to contend with. There is the lack of convenience for manufacturers in teaming their raw and manufactured material, and to them it is in many cases a matter of serious loss. In more than one of these towns I believe it could be proved that if the width of streets had been regulated according to their traffic requirements, and not according to a hard and fast rule, it would have been possible to have saved enough of the money spent in laying temporary construction, maintenance and expensive sidewalks to have made quite good streets. Partly because of these very wide streets in residential areas owners find it difficult to face the heavy cost of paving.

But residential streets are not only too wide, they are too frequent because of our crowded and shallow subdivisions and because of the absence of plan. I could give examples of portions of towns where twice the length of street is provided than is necessary, and I propose to append a diagram to this paper showing that with more open development, i.e., with less street area and more open land round the houses, the saving in cost of street alone could enable us to have nearly twice as much land attached to each average workingman's home without any extra capital cost. In other words, the saving in local improvements could be made to pay for the extra land required to double the depths of our subdivisions in a suburban working-class area.

The land given up to residential streets, and our haphazard system of allowing factories and residences to be mixed together in all parts of our towns without any discrimination, makes it difficult on the one hand to get wide main thoroughfares where they are required, and, on the other hand, to secure a higher standard of road construction giving access to areas that should be reserved for manufacturing purposes. Heavy trucks and wagons which use the streets in industrial areas require heavy roads. But because we do not reserve special areas for manufacturing and other areas for residential purposes we have either to make our roads too light for manufacturing purposes or too heavy and expensive for residential purposes. Thus in regard to width, length and construction of streets we have to keep up an extravagant standard because we allow our towns to grow up without a proper plan. It is because of this that the advantage of having wide roads where these are needed for through traffic is often questioned, the plea being that to provide for very wide roads casts too great a burden on the present generation for the benefit of posterity. That plea rests on the erroneous assumption that the intention is to make all roads wide and not to vary and regulate their width according to the use to which they have to be put. Under a proper scheme roads should not as a whole occupy a greater superficial area than they do now, but complementary to the narrow residential street fringed with deep front gardens would be the wide traffic thoroughfare.

In laying out main arteries it is cheaper as well as better to make our roads wide enough to meet future needs. This is particularly so where such roads are required for street railways. Every road which is intended to carry two streams of ordinary traffic and two lines of street railway besides should not be less than 100 feet and should, where practicable, be 120 feet wide. One illustration of the economy to be secured in this connection will suffice. I am compelled to take for my illustration British experience, as I understand this Conference wants facts, and my acquaintance with Canadian conditions is not sufficient to enable me to cite cases in this country. But such facts as I do present refer to matters of principle which have direct bearing on our Canadian problem, even if conditions and costs differ. In Liverpool, Mr. John Brodie, M. Inst. C. E., the City Engineer, has demonstrated that he could widen an existing 40-ft. road to 120 feet at a slight extra cost compared to widening to 80 feet where such a road ran through open country and was required in part for a street railway.

His alternative costs were worked out as follows for these widths:

Widening to 80 Feet (tramways paved)

Cost of land, 13 1/3 yds. at 5s.	£3	6	8
Street works, per yard lineal	7	2	6
Tramways (including paving) 1 yd at £6 15..	6	15	0
	£17	4	2

Equals £30,286 per mile.

The above estimate includes for the reconstruction of the old road to suit new levels.

Widening to 120 Feet (tramways in grass)

Land for new road, 13 1/3 yds. at 5s.	£3	6	8
Street works per yard lineal	4	13	7
Tramways (in grass), including land, 1 yard at £6 16 8	6	16	8
	£14	16	11

Equals £26,128 per mile.

This estimate does not include for any alteration to the old 40-foot road.

This is a special case, no doubt, as in making the 120-ft. road it is possible to save the cost of reconstructing the existing road; but even apart from that the wider road would not seriously exceed the cost of the narrower road. The saving of £4,160 in the second case would be nearly sufficient to enable an extra 40 ft. of width of land to be purchased at a price of 3s 6d per yard. That price would be sufficient, in view of the greater advantage to the owners of real estate in having the wider road. In any case, if such a road could be made in a country district obviously the 120-ft. road could be made cheaper than the 80-ft., as the cost of land would be much less and the saving in construction would be the same. The saving in paving alone due to laying the tramways in grass is £3,000 ($15,000) per mile. Tramways running on grass are less noisy and do less injury to the land from a residential point of view. In fact, one of the advantages claimed for the wider road is that it causes, and has caused, builders to erect larger houses, thus keeping the richer inhabitants within the city boundaries. There is nothing more important in a town than to keep well-to-do ratepayers within its borders. It keeps down the taxes by keeping the assessable values high, and keeps a class in the city whose presence is most desirable from many points of view. There is no need for these wide roads to be immediately constructed of their full width. The essential thing is to earmark the land for them, that is, to plan them. The cost of construction can be spread over a long period, but if the land is not acquired it may be used for building, which would prevent future widening except at prohibitive cost.

Nearly all the discussions that have taken place at this Conference indicate the necessity of planning our systems of roads and streets in a comprehensive manner. Wearing surfaces have to be adapted to local traffic as well as to traffic outside the city; to factory areas as well as residential areas. The complex question of modern traffic problem requires consideration to be given to the width of main arteries before buildings are erected upon the road frontages. In the financing of our roads we have to recognize that everything that is spent on unnecessary width and construction on our secondary roads is so much capital withdrawn from use in improving our main arterial system.

As the Deputy Minister of Roads of Quebec has pointed out, roads are largely located to suit property lines rather than for suitable foundation and grades. This not only increases the cost and difficulty of construction, but it adds greatly to the cost of buildings. In many of our Canadian towns people who want gardens cannot obtain them unless they have twice the width of plot of land that is really necessary for the use of a house. Instead of having the land subdivided so as to give them space at the rear of buildings they have to acquire land at the side, with the result that they probably have to pay twice as much for local improvements as is really necessary. In some of our cities, such as Ottawa, there are not hundreds, but hundreds of thousands, of yards of road frontage unoccupied by buildings and forming a burden of cost upon the owners, largely because of the shallow nature of the subdivision. When, in addition to this extra width of frontage, you have an unnecessary width of road, the wonder is not that land development is so expensive in Canada, but that it is so reasonable in cost.

Even when we come to consider bridges and culverts, how often have we to face unnecessary difficulties, owing to lack of planning of lines of our roads? The need for dust prevention has a close relation to the question of making unnecessary width of pavement, and who that has studied the enormous cost of maintenance but has been forced to recognize that half of the trouble is in maintaining more surface than the community can find capital to construct properly at the outset.

Col. Sohier is to read a paper in which he will claim that roads be built to suit the traffic over them. That is a claim which one would think need only be stated to find unanimous acceptance, and yet in actual practice we have paid little attention to it in planning and designing our roads. One principle that has often guided municipalities in determining width of roads is that the road has to be wide in order to secure sufficient air space around the buildings. In some towns it is laid down that roads have to be 60 feet wide for purposes of air space, and yet the owners of the land are allowed to build up almost every available yard of their site with buildings, and there is a complete absence of air circulation except in the streets. If we are unable to devise means to secure adequate air space and light to our buildings, except by means of making wide roads, I suppose we must adhere to it, but to permit this would be to admit failure to control a matter which is now being controlled by most civilized countries in Europe. We have to recognize that provision of air space is entirely separate from the question of street width, and that adequate air space should be provided by those who erect the buildings and not by the public as a whole. Streets are for the purpose of giving facilities for circulating traffic and for providing access to buildings, and they should be designed for that purpose only. There is probably one matter only in respect of which the width of streets has a direct relation to buildings, and that is in respect of the height of buildings. Such heights should have some relation to the width of the street. That is needed not only to secure light and air, but to prevent traffic congestion as the town grows. Apart from that question, however, we should determine the question of light and air to buildings by fixing a minimum distance between all buildings on opposite sides of the street without regard to the width of the street itself, by limiting the amount of land in the subdivision which should be occupied by actual building and by requiring a minimum angle of light to all windows. It may be a revelation to those who on this continent are indifferent to the question of heights of buildings to know that London, with its comparatively low buildings, is regarded by English architects and engineers as not being sufficiently restricted in this respect. The height limitation in London is approximately 100 feet, and it is considered that this height should only be permitted in streets of 100 feet in width. Apart from special cases where the evil of high buildings has already been established, no buildings should be higher than the width of the streets facing them. Ample justification could be given from every point of view, including that of the interests of real estate, for such a limitation.

Four Classes of Areas

In considering the planning of streets and roads we have to deal with four classes of areas:

(1) Areas already built upon, like the developed portion of the city of Toronto.

(2) Suburban areas which are likely to be used for building purposes in the near future.

(3) Rural areas, especially those which lie between centres of population.

(4) Sites of new towns which are likely to grow up in the future.

In the former we are, of course, largely handicapped by existing circumstances, and the physical difficulties are such, especially where we have undulating ground to deal with, that it is almost impossible to secure satisfactory change of plan. At the same time, it requires to be dealt with in a systematic way, although approached from a different standpoint than the areas which are not yet built upon. We have to consider whether it is wise and more economical to widen a street or to make a new diagonal street instead of widening. In that connection consideration has to be given to the importance of directness of route and to the provision for future expansion. In London several widenings have been carried out and soon afterwards these widenings were proved to be insufficient. It is nearly always a weakness of administrators that they fail to look far enough forward in fixing the width of main traffic routes. The great cost of carrying through improvements in such areas is one of the strongest arguments in favor of planning areas not yet developed. In the city of Leeds in England extensive improvements have been made at great cost. The City Engineer, Mr. W. T. Lancashire, recently stated in a paper that the improvement schemes in Leeds had cost over twelve million dollars. This, he has claimed, furnished a definite admission of wrong-doing in the past and a powerful justification to town plan new areas in order to save such expenditure in the future. There is not only the actual direct saving, but there is the enormous saving of time and cost to manufacturers and the community in general by having main streets of sufficient width.

In a memorandum prepared for the Royal Commission on Traffic, by Sir Wilfrid Berry, it was estimated that the wastage due to delay caused by insufficient means of locomotion would amount to about thirty millions annually in London in the earning capacity of the workers alone. With our high wages in Canada and the need for stimulating our industries there is nothing more important than the conserving of the earning capacity of our workers.

In Leeds the cost of widening streets was demonstrated to be rather greater than the cost of constructing new roads through condemned areas. The Engineer's figures show that the rate per mile for street widening varied from about $1,000,000 to $8,600,000, and that the rate per mile for roads constructed through condemned areas, excluding subways, was from $320,000 to $900,000. In the latter case no allowance is included for surplus land, but in a scheme of this kind power should be taken to condemn more land than is actually required, so that the community can reap some advantage from its improvement by disposing of the sites fronting on the new street or streets. The great Kingsway scheme in London has frequently been referred to as an example of replanning, but it is difficult even yet to obtain accurate figures of the cost of that scheme, which includes all the advantages of excess condemnation. The total estimate of cost was about thirty millions. This sum was spent in acquiring an unsanitary area where 3,172 persons were accommodated. The new Kingsway is 10 feet wide, includes a tramway subway underneath, and takes the place of a series of narrow alleys and streets which was a danger spot in London. Although the County Council of London is unlikely to obtain a return from the disposal of lands to enable it to materially reduce the cost, it may fairly be contended that the advantages in directness of route, improvement of alignment, better means of traffic routes and clearance of a very unsanitary district not only justify the expenditure, but outweigh any advantage that would have resulted from the widening of the streets that were formerly existing. Generally speaking, in Britain, where the question of reconstructing roads through condemned areas exists, it has been found that it is often cheaper and is nearly always better to construct new diagonal roads than to widen existing roads, where the property fronting on the latter is of a permanent character.

Providing for Future Expansion

The issue before the engineers of this country is not only to have good roads in the sense of having them properly constructed, but to endeavor to foresee and adequately provide for the future expansion of our towns by planning these roads. We want to save costs on minor roads, to lay down main radial roads of adequate width, and of good alignment and grade, and to connect up these radial roads in our suburbs by good ring roads. The question of directness of route cannot be considered in isolated streets or areas. Our practice of having straight streets on the rectangular plan, with utter disregard to level and directness of route between the centre or the circumference, is entirely wrong in principle and costly in practice. Curved roads are often an advantage subject to a view being maintained of not less distance than 100 yards. It is more important to avoid sudden deflections, steep grades, and collision points than easy curves. Curves are often a physical necessity to avoid the removal of enormous quantities of material. Engineers are not sentimentalists, but even as practical utilitarians they are not indifferent to the value of giving some aesthetic effect to a road if this can be done without loss of utility. Some regard has to be paid to beauty, to the preservation of trees and to architectural effect, and, as it has been stated elsewhere, relief of traffic is not inconsistent with relief to the eye. I cannot enter into the question of alignment of streets except to urge the necessity of regard being paid to the physical characteristics of the site, to the disposition of buildings and to the need for securing picturesque effects where that can be done without loss of utility.

I have endeavored to indicate some of the evils which arise from want of planning our roads and streets, and some of the principles which should guide us in our future action. It is desirable in conclusion to indicate some of the methods which we should adopt to secure the removal of existing evils and the application of sound principles. It has been stated that this Conference is concerned with facts and not with opinions, and so far as suggesting any policy for future action is concerned, I shall confine myself to proposals that have been tested by experience. But it is as well to remind ourselves that so-called facts and experiences are often misleading, and that sound principles, even when not tested by experience, should not be disregarded. Every road engineer knows how easy it is to make a mistake in accepting the experience of one locality or of an isolated case as a guide. That does not arise when our facts are based on sound general principles. We have still to gain much practical experience in regard to planning our roads and streets, and as time goes on we shall learn lessons which will correct and alter our views regarding details, but on the main principles of whether we should plan our systems of communication or leave them to chance growth and at the tender mercies of the sub-divider, I claim that we all have enough experience to enable us to accept the former as sound in practice as well as theory.

How then is it suggested that we should proceed? We have the example from what has been done in Britain under the Town Planning Act of 1909, and I shall briefly refer to the schemes which have been carried out under that Act so far as these schemes deal with the planning of roads.

In Birmingham, the Engineer has prepared a plan of the arterial road system which it is proposed to adopt within an area of 38,000 acres. Several town planning schemes have been or are being prepared to deal with the whole of the undeveloped area within the city, and with some area outside the city. The schemes include provision for main arteries from 80 ft. to 100 ft. wide and secondary arteries of from 40 ft. to 60 ft. wide. Only the lines of the principal roads are fixed under the scheme. The Corporation will make these roads at its discretion, but owners have a right of appeal against delay. The owners of land along the frontage of such roads will, as soon as their land is used for building, contribute $17 per yard lineal on each side; this is about half the cost of the street and is the proportion they would have to pay if the streets were of by-law width (45 ft.). All other subsidiary streets, although not put on the plan, have to be laid out in conformity with the arterial road system at the expense of the owners. They have to be made of such widths and on such sites as the Corporation may require, and when an owner wishes to develop a portion of his estate he must submit a plan of the streets for the whole. This method secures co-operation between the Corporation and the owners, apportions the cost of street making in an equitable manner, secures wide streets or narrow streets as the case may require, and allows of elasticity to meet altered conditions. In some cases not more than 12 houses and in others not more than 15 or 18 can be erected on the acre on an average, and parts of each area are limited for use for residential purposes, other parts for manufacturing purposes, and others for open spaces.

The schemes include provision for compensation for betterment, demolition of buildings, air spaces round buildings, and adequate building lines. As far as practicable building lines of 15 ft. from the road boundaries are secured, with a minimum width of 72 ft. between all buildings on both sides of a road. Thus, on the main arteries of 100 ft. wide the distances between the buildings will be not less than 130 ft., and on the narrowest roads not less than 72 ft. The following are details of the alternative cross sections:—

(1) Roads on plan to be constructed by Corporation:

100 ft.—Primary section—Pavement 35 ft., grass 43 ft., sidewalks, curbs, etc., 22 ft.

Ultimate section—Same construction but with street railway laid in the grass.

80 ft.—Pavement, 35 ft., grass 22 ft., sidewalks, etc., 23 ft.

60 ft.—Pavement, 32 ft., grass 14 ft., sidewalks, etc., 14 ft.

50 ft.—Pavement, 32 ft., grass nil, sidewalks, etc., 18 ft.

42 ft.—Pavement, 26 ft., grass nil, sidewalks, etc., 16 ft.

(2) Alternative sections for estate development:

82 ft. between buildings—

60 ft.—Pavement 18 ft., sidewalks 12 ft., grass next boundary 30 ft.

50 ft.—Pavement 18 ft., sidewalks 12 ft., grass next boundary 30 ft.

72 ft. between buildings—

42 ft.—Pavement 18 ft., sidewalks 12 ft., grass next boundary 12 ft.

36 ft.—Pavement 18 ft., sidewalks 10 ft., grass next boundary 8 ft.

20 ft.—Pavement 8 ft., sidewalks 12 ft.

The latter must not exceed 150 ft. in length and have a turning place for carriages. It is intended to meet cases where a few houses are erected on a carriage drive, leading out of a through thoroughfare. These schemes deal with numerous other matters, but the above indicates some of the provisions regarding streets which are likely to be of interest to this Conference. The Corporation will probably spend $50,000 in preparing these schemes, getting them approved, preparing surveys, sections and estimates for arterial roads, etc. In addition to that it may have to ultimately spend up to $2,000,000 in carrying out its own part of the cost of construction. But this is in a city of about 1,000,000 inhabitants with an area of 38,000 acres, which has been spending tens of millions of dollars in street reconstruction in the past, and even with such expenditure securing inadequate results.

I have only time to briefly refer to another scheme for what is practically a rural area, although it is likely to undergo rapid development in the near future. In the Ruislip Northwood scheme dealing with an area of 5,900 acres, a scheme has been prepared fixing the lines and widths of the main arterial roads and how cost is to be met, securing that all future subdivisions will conform to the skeleton plan without definitely fixing the lines of subsidiary roads; fixing building lines on all existing and proposed roads at a distance of 15 ft. to 35 ft. from the street boundaries; widening existing streets and adjusting boundaries; diverting or stopping of land to be built upon, cubic space per room, height of buildings (in no case higher than width of street), delimitation of areas for factories, workshops and residences, character of design of buildings, protection of trees, prevention of unsightly advertisements, reservation of land for open spaces, etc.

The cost of preparing this scheme has been $5,000. The ultimate cost to the ratepayers of carrying it out will be about $150,000, divided as follows:—

Land for open spaces, cemeteries, etc.	$ 30,000
(over 90 acres of open spaces were given free by owners, by co-operation under the scheme).	
Compensation and purchase of buildings for widening	20,000
Making and altering roads	100,000
	$150,000

This expenditure will be met in the future as the need arises, and as the benefits are derived by the community. For this small sum this local authority has obtained advantages which if obtained piecemeal would cost ten or twenty times as much. The improved road system or the amount of open space obtained are, either of them, worth the expenditure. These enormous advantages are the result of planning and of co-operating with the owners before development takes place. The owners benefit as well as the local authority, and an added security is given to the purchaser of property.

About two hundred municipalities are at work in England either preparing similar schemes or getting authority to prepare them.

In Canada Town Planning Acts have already been passed by the Provincial Legislatures of Nova Scotia, New Brunswick and Alberta, and others are considering the matter. Those who are interested in good roads and in the planning of roads should support the movement to have similar legislation in the other provinces and to encourage its application in the different municipalities.

A revised Act is now before the Legislature of Nova

Scotia, and it is also being considered by the Commission of Conservation for the purpose of recommendation to the other provincial legislatures.

St. John, N.B., is the city which has the credit of being the first to apply the Act in Canada. It is proceeding with the preliminary steps with a view to preparing a scheme for about 10,000 acres, of which over one-half is outside the city limits.

To secure the application of democratic principles there must be regulation of the abuses of liberty, protection of legitimate private interests, and consideration of the liberty of the citizens as a whole in contradistinction to the liberty of individuals. We flatter ourselves that we live in a state of government based on democratic principles, and yet, so far as the planning of our roads is concerned, we follow the policy and principles of the anarchist. The result is that owing to a false and mistaken view of the relation between private and public interests we allow both to suffer. That has been so in the past, but we have now arrived at a stage when both expert and average public opinion recognize the absolute need for exercising foresight and common sense in regard to the whole question of planning our system of roads, particularly in our growing cities and towns. All we now have to do is to agree on the right principles on which to proceed, and it is with the object of indicating some of these principles, and illustrating the extent to which they are being adopted in practice elsewhere, that I have contributed this paper to this Conference.

Dust Prevention

By Major W. W. Crosby, Consulting Engineer, Baltimore, Maryland

Up to ten years ago the subject of dust prevention on roads had received comparatively little attention except in a few specific instances and in connection with city street maintenance. A few fruit-growers had complained—especially those whose property was located along stretches of shell or soft limestone roadway—of the damage done by clouds of dust which in dry weather covered their growing trees and vines, but in the main a considerable amount of dust from even improved roads seemed to be regarded as an inevitable accompaniment of the serviceable roadway.

Along came, not Ruth, but the automobile. Immediately the dust question was vastly increased in importance and brought to general attention. The abutter began to receive the support and sympathy he deserved from the neighbors and from the visitors to the locality, from the travellers through it, and even from the automobilists themselves, whose driving of their cars was interfered with by the clouds of dust raised over the roadway.

In fact, the wide penetration or distribution of the effects of the increased dustiness reminds one of the story of the colored men's discussion on the artillery now in use abroad. Strickland Gillilan tells it thus:

Three colored men stood on a Baltimore street corner.

"Them German cannons kin hit yo' fi' mile off!" said George.

"That ain't nuffin'," scorned Joe. "Them thah French guns pick a man outer a tree, ten mile off!"

Jim's scorn made him almost speechless.

"You all ain't said nuffin' 'bout shootin'—huh up! You all ain't mentioned GUNS! W'y, all dem English shootin' irons needs is to know yo' address!"

Even "the address" of the road authorities seems to have been given the dust, for they were forced to consider seriously the question first of dust suppression. Naturally the underlying question of "Dust Prevention" followed.

There were doubtless other factors aiding in bringing about the consideration of this subject—such, for instance, as a greater public interest in and demand for better hygienic conditions on the roads as well as elsewhere, and a realization of the importance of protecting the roadways themselves from the removal from their surfaces of fine material valuable in protecting the road crust itself from deterioration.

It has never been suggested, apparently, that the remedy for the unhealthy and unsatisfactory dustiness of the highways was the abolition of the motor vehicle. On the contrary, their increase in numbers and their development for all sorts of purposes seem to be inevitable, and probably fortunate. Therefore the antidote seems to be the curing of the defects of the roadway.

There can be no one best material or one best method for this purpose, as the same conditions are scarcely ever met with twice. Therefore some discussion here of the various conditions, materials and methods of use may be pertinent.

It is generally agreed among highway authorities that dust proceeds not only from attrition of the roadway surface by hard tyres and the feet of animals, but comes also from the grinding on each other of the pieces of aggregate or road-metal forming the pavement or crust. This internal wear of the surfacing is much greater than was formerly suspected, and it accounts largely for the layer of mud and dust to be found on macadam, for instance, even when freely removed from the surface at frequent intervals by scraping or sweeping.

The amount of the internally produced mud seems to bear a relation to the weight of the traffic, and to the moisture present—such as results from sprinkling with water—as well as to the friability of the stone used and to the methods of construction.

Heavy vehicles, even when shod with rubber tyres, set up severe strains in the road-crust and tend to make the particles of stone in macadam rub against each other in resisting these strains. If water is present in excess in the mass at the same time, the stones wear into mud more easily. Soft materials, of course, produce more fine material than harder ones under the same conditions. If the particles of material composing the macadam are closely knit and mechanically bound together by their angular shapes, they naturally move less under the strains and the rubbing, and the amount of fine material produced is consequently less.

Real dust prevention, therefore, it will be seen, begins with the construction of the road-crust. In this work it will be necessary, in order to avoid as far as practicable the subsequent production of both superficial and internal dust—which latter rises eventually to the surface and becomes appreciable externally—to select road metal of the most appropriate hardness considering the traffic, to provide by proper drainage against the continued presence of an excess of water in the road-crust, and to secure the firmest angular bond that the metal is capable of in the macadam.

It has been found that even where good road metal was used, and where the traffic was light, road-crusts built with the use of an excess of fine material in their first construction have proved to be more dusty under the same conditions than where the fine material used was kept to a minimum. Evidently the excess of fine material, not only from its presence easily furnished more dust to be raised, but also prevented the closest interlocking of the coarser particles. This resulted in an increased movement of them under strains on the surface, and consequently the production of more internal dust. The dustiest kind of stoned roadway is an old turnpike where the stones are liberally mixed with earth in order to help their compaction under traffic, and where they are bedded in a matrix of fine material, like plums in a pudding.

With modern machinery and the construction of the macadam by sufficient rolling the use of fine material should always be kept as low as possible. It will have to be used to some extent for filling the voids between the coarser particles, but even then a selection for the finer particles should be made, and as far as practicable that chosen should be highly resistant to influences tending toward its reduction to dust. It will pay, in using limestone, to use at least 50 per cent. of the fine material required for bonding the macadam of clean sand such as would be suitable for mortar. In many cases all the fine material necessary may profitably be such sand, even when used with crushed trap rock; and with shells no fine material except such sand should ever be used. The best results are never obtained by the use of clay, silt or loam for binding macadam.

No matter how built, a roadway, even in city streets, may become superficially dusty, and the suppression of this dust may be desirable. Frequent cleaning or removal of the dust with the dirt may solve the problem, or it may be impracticable to that extent, and necessitate other measures.

The simplest of these is sprinkling with water to "lay the dust." The objections to this are: that it is seldom done efficiently because it has to be done periodically, and that between the times of sprinkling when a temporary excess of water is applied the surface condition varies from muddiness to dustiness again. Further, the cost of sprinkling with water may be too high if that is the sole means of suppressing the dust. Cleaning by sprinkling or washing the street surface may be satisfactory under some city conditions.

Efforts have been made to increase the effectiveness of water-sprinkling by the use of sea-water, which contains hygroscopic salts, or by the addition of such salts as calcium chloride to the water. Under some conditions the results have seemed to be successful to a certain extent. These salts absorb moisture from the air and tend to keep the roadway surface moist enough to hold down the dust even after the water originally applied with them has disappeared and failed to do this. Their effect, however, is not permanent, nor is it powerful enough to meet severe conditions of traffic tending to produce or raise dust. Moreover, these salts are soluble, and are washed away to the gutters and water-courses by rain. Their re-application becomes necessary at intervals more or less frequent, according to local conditions.

The salt (calcium chloride) itself has been used on the same principles by being spread in a finely divided and dry state over the roadway surface. When used in this way the effects of it are perhaps stronger and more noticeable or lasting.

What might be called another "chemical" process consists in the use of concentrated sulphite liquor, usually produced as a waste or by-product by wood pulp mills, and commercially known as "Glutrin." The "Glutrin" is used either with or without the addition of water. The effects of the "Glutrin" are composite. It has some cementing powers such as exist with sugar. It also, through its tannic acid content, has a chemical effect on some of the materials composing the road-crust, which tends perhaps to strengthen their normal binding power. For instance, it may make a clay much more plastic and tenacious. Further, road surfaces treated with "Glutrin" seem to "set up" harder and to resist abrasion better.

The "Glutrin" is, however, more or less soluble in water, and will be washed out of the road-crust eventually, even if the impregnation is fairly deep, as subsequent wetting of the crust brings the "Glutrin" gradually to the surface. In short, under some conditions the use of "Glutrin" as a dust preventive has proved fairly successful.

The most successful of the materials used for either the prevention or the suppression of dust on roadways are the bituminous materials, and they can generally be used for both purposes. If the voids in the road metal are filled with bituminous material the internal production of dust is prevented. Even the external production of dust may be reduced because of the cushioning effect of the pitchy matrix and the greater resiliency thus given the piece of road-metal subjected to the shock or attrition of traffic. If the bituminous material is only applied to the surface of the road-crust, it still reduces the dust nuisance by suppressing the raising of the dust underneath or mixed with it, and in many cases by protecting the road-metal from any superficial wear from traffic. Further, a proper bituminous material possesses to a larger degree than do other materials the ability to absorb a considerable amount of dust produced elsewhere and brought on to the roadway through various agencies. This is important from the economic point of view.

The question of what is a "proper" bituminous material will depend so largely in any case upon the local conditions that no close definitions can be given in this paper. Perhaps it might be said that, generally speaking, the asphaltic oils are better for this work than the paraffin base oils; that a good bituminous dust-layer will give benefits other than the mere reduction of dustiness on the roadway—such, for instance, as the reduction of noisiness and an increase in sanitariness—and that usually its proper application will be in the interests of both economy and general satisfaction.

On the other hand, the improper use of an unsuitable bituminous material will produce results on the roadway second to none as far as nastiness and general dissatisfaction are concerned.

In closing this necessarily brief discussion of an important subject, allow the speaker to repeat what he has said so often—that is, try to be wise in this work and profit from the experience of others who have used the materials, and not depend wholly for information or advice on those who are pushing the sale of some so-called "dustlayer."

Concrete Roads and Streets

By H. S. Van Scoyoc, Chief Engineer, Toronto-Hamilton Highway Commission

THE use of concrete as a paving material is fast passing the experimental stage. Although it is doubtful if there is yet sufficient information at hand to permit of a close approximation as to the life of concrete pavements under varying conditions of traffic, soil and climate, there are particular cases on record showing the economy of this type of pavement after periods of actual use ranging from five to ten years.

There are at least a few streets to-day in good condition after twenty years of service, which would seem to show that if there were failures in the earlier work they could probably be traced to the same causes that will produce failures now. It is a fact, however, that there was more reason for attempting mixtures weak in cement then, when a barrel of cement cost from three to four times as much as it does now. In addition, the remarkable increase in motor traffic during the last ten years has made it much more difficult to maintain those types of paving in which the various separate units are not held together by a positive binder as is the case with concrete. It has also greatly increased the life of concrete or similar surfaces because of the decrease in wear from rubber-tired vehicles as compared with that from horse-drawn, steel-tired traffic.

If it is granted that there must be some merit in a paving material the total yardage of which in Canada and the United

States increased in 1913 from 9,000,000 square yards to 18,000,000 square yards and of which 16,000,000 square yards were laid during 1914, it ought to be worth while to note some of the facts that have been established by experience—more particularly during the last five years.

Sub-Grade

The fundamentals in road-building hold good for concrete just as for the other types. A system of drainage must be provided which will keep the water-level well below the sub-grade. This is especially true where frost has to be contended with. Where the natural soil is heavy clay or other material that is not self-draining there are certain advantages in placing the concrete upon several inches of gravel or other pervious material. If surface water does get beneath the concrete it then has a better opportunity to get away. In addition—especially in hot, dry climates—there will be no trouble from cracks developing in the concrete slab due to the drying out and cracking of the sub-base material. This may occur when the concrete is laid directly on the natural soil. The sub-grade should be constructed with the idea of having it evenly compacted for the full width of the road section. This means special care where the concrete is replacing a highly crowned macadam road which was also probably not of as great a width as the new road will be. No doubt the bearing power of the soil can be greatly increased by careful rolling with a heavy roller, and this is certainly very desirable; but it is of at least equal importance that all parts be evenly compacted.

In order that the greatest thickness of concrete shall come where it is most needed the sub-grade should be flat up to a width of roadway that does not increase the thickness of the concrete slab at the centre unreasonably. With the crown usually given concrete roadways (1/100 of the width) the limiting width would be about twenty feet. Beyond this width the sub-grade should be slightly crowned so that the thickness of the concrete at the centre will remain constant.

Materials

There is some difference of opinion as to whether it is the mortar composed of the fine aggregate and cement or whether it is the coarse gravel or broken stone that has to resist the wear on the road surface. It seems reasonable to suppose that both contentions may be right; that is, if a uniformly tough, hard fine aggregate is used with a comparatively soft coarse aggregate the mortar may take the wear, while with reverse conditions the wear many come on the coarse materials. With ideal materials both fine and coarse aggregates should be tough, and uniformly tough—for it seems almost axiomatic that if construction is properly carried out the life of the pavement will depend directly upon the quantity and character of the traffic and the wear-resisting qualities of the aggregates. Materials that show uniform wear are certainly to be preferred over those containing some very tough and some very soft particles.

It is a mistake to use any material as a fine aggregate which has not been actually mixed with cement and made up into test pieces and compared in strength with the results secured from the same cement and standard sand. In more than one instance sands which to the eye have appeared fairly good show absolutely no strength even in long time periods. Needless to say, the cement should be of known good quality; but it should not be expected to make up for the deficiencies of the other materials, which even in concrete for road work comprise a bulk about five times that of the cement.

Proportioning

While the proportions may be varied slightly according to the nature of the aggregates used, in most of the work now being undertaken a mixture of about one part of cement to one and one-half parts of fine aggregate to three parts of coarse aggregate is specified. It seems strange that in road work there have been so few attempts made to get away from wheelbarrow or bottomless box proportioning. It is one part of the work in which less progress has been made than in most of the others. There have been some exceptions—notably one road in Oregon, where the proportioning was done by bins at a central plant and three charges for the drum of the mixer carried in each car of the Industrial Railway train that was used to convey the material to the road. On one of the Maryland roads small dump cars were used in connection with a narrow gage track. Partitions were placed in the cars so that one side of the car held exactly one charge of cement and fine aggregate and the other side the right quantity of coarse aggregate. Each car in this case thus held the material for one batch. Both schemes have been reported as satisfactory.

Mixing

There has been wide variation in practice as to the time and speed required for mixing, but it is now realized that the number of revolutions a minute of the drum may vary with the type of mixer, the size of the drum and the nature of the mixture. For satisfactory results it is usually necessary to keep the batch in the drum for at least one minute. It is very desirable that a uniform mixture be secured. The concrete should be of such a consistency that it will stand without flowing when deposited. It should not be sloppy, but it should be wet enough to settle in place with the tamping that it receives from the strike-board.

Finishing

When the width of the road or street is not greater than eighteen feet the proper shape can be given the concrete by means of a strike-board or template cut to the desired crown. It rests on the side forms, and is worked slowly up and down, and at the same time slowly forward, by a man at either end. If the surface is to be true the side forms must be carefully set to line and grade. Any imperfections here will be reproduced on the road surface. For wider streets a more satisfactory surface is usually secured by driving stakes to the proper grade at intervals of, say, four feet and having the finishers work to the tops of them—removing them, of course, when they have served their purpose. In any case the surface should be finished with a wooden float before the concrete has set up. The finishers should remove any little depressions or high spots that may exist, and should leave a surface that is even but not smooth.

Joints

Transverse joints are now usually spaced at intervals of about thirty-five feet, although the spacing varies considerably above and below this figure. The joints need not be wide, but are preferably filled with a bituminous felt that will accommodate itself to the changes in the length of the slab with varying temperatures and moisture content. They should be waterproof, and should be so placed that there will be no unevenness in the surface of the road at that point. In no other part of the construction will lack of careful workmanship be so evident as at the joints. There has been some tendency to reduce the joint thickness at the time of construction to 1/16th of an inch or less and provide no joint filler. There is an element of danger in this method where the ranges of temperature are as great as they are in this climate. In one case where cross joints were widely spaced joints that were tight during construction opened fully ⅜ of an inch the following spring, due to contraction during the winter. Water could enter under these conditions and cause serious trouble. Joints are now usually made at right angles to the centre-line of the road, although in some cases they have been paced diagonally across it. In any event, they should be made vertical, as there have been some instances where slabs have been forced upwards when both faces were not perpendicular.

Protection

If there is wind or strong sun the surface should be covered with tarpaulins just as soon as they can be placed without marking the concrete. When the concrete is about twenty-four hours old this covering should be replaced by about two inches of sand or soft earth. The concrete should be sprinkled just as soon as it will stand it without marking, and should be kept damp for at least ten days. Large quantities of water are required for concrete road construction, for the sub-grade should be well moistened before the concrete is placed, and in addition to the water required for mixing there should be a supply for sprinkling.

It has been said that a year of serviceable life is added to a road for every day that traffic is kept off it. When possible no traffic should be permitted for at least three weeks, and if the weather is cold and damp this period must be increased.

Two-Course Work

It is a mistake to say that satisfactory two-course pavements cannot be laid; many examples could be cited to disprove the statement. There are several disquieting factors introduced, however, with this type of construction. If the top course is not deposited almost immediately after the bottom course there is danger that the two courses will not unite properly. Usually the top course is much richer than the bottom. This is undesirable for two reasons. In the first place, the expansion and contraction of the concrete varies with the srength of the mixture, and in the second, the expansion and contraction vary with the moisture content. The moisture content will probably be greater in the bottom course, because it will usually take up some moisture from the sub-grade, while the top course will be practically waterproof. In either of these cases there must be unequal movement of the two courses.

However, where local materials are poor in quality and economy is necessary there is a justification for using the cheap local materials for the bottom course and bringing from a distance materials of suitable quality for the top course.

Reinforcing

No concrete road or street will be injured by the addition of reinforcing. It is almost certain, however, that all cracks of such a width as to be visible to the eye will not be prevented by the addition of the weight of reinforcing usually specified for concrete roadways.

Where subsoil conditions are bad—due either to the nature of the material or to the openings that may have been made for pipe ines—there is value in reinforcing. Where the appearance of a road or street is of major importance reinforcing should be used. It is a question, however, whether it has yet been shown that reinforcing is economically justified for the usual widths of country roads where an occasional crack cannot be considered a serious fault.

Maintenance

It has been said that the justification for the use of concrete lies in the low maintenance costs. With proper materials and workmanship the annual charge for repairs to the concrete surface should be small. There may be some surface pitting; there may be some cracks requiring attention; there probably will be some joints to be taken care of; and on country roads there certainly will be shoulders to maintain and ditches to keep open. Undoubtedly some provision shoud be made for the maintenance of even a concrete road.

Costs

Naturally the cost of the roadway proper will depend upon the cost of the cement, the fine aggregate and coarse aggregate on the road, and the labor cost for combining them properly and placing them in the road. The cost of materials will vary greatly with the distances they must be hauled. The labor costs will depend to some extent upon the organization. In rare instances, where conditions are particularly favorable, the cost per square yard may be as low as one dollar. Usually the cost should be below one and one-half dollars. An average price in this vicinity will be in the neighborhood of $1.35.

In conclusion, there is to my mind an analogy between concrete road building and the statement in mechanics that the work taken out of a machine cannot exceed the work put into it. In other words, if a satisfactory road is to be built there must be a constant effort to secure the highest possible grade of concrete. Concrete is its own inspector. In concrete roadways concrete has its most severe test. The material is equal to the test, but it is at the mercy of the user.

Mussens, Limited, Announce "Business as Usual"

The many friends of Messrs. Mussens, Limited, the well-known Montreal firm that recently went into liquidation, will be interested in the announcement made over the signature of the President, Mr. W. H. C. Mussen, that Mr. John J. Robson, chartered accountant, of Montreal, has now been appointed Permanent Liquidator to the Company, and that the Court has granted the application of the firm to continue business.

Messrs. Mussens are now carrying on an active campaign for business, and they will make every effort to reduce their stock, collect open accounts, and reduce overhead charges, with a view to ultimate reorganization. All purchases made by them from now on will be paid for by the Liquidator.

The extended and sound connections made by the firm throughout constructional Canada and their high standing will doubtless ensure their obtaining a greater measure of business than ever before. The assurance that all inquiries will receive prompt attention and that orders will be filled without delay needs no substantiation at our hands.

At the recent meeting of the Associated Boards of Trade held at Sherbrooke, Que., road work in the province came in for considerable discussion. The statement was made that road construcion in Quebec would continue with unabated activity, and that in all probability the trunk road from Lennoxville to Norton would be put through this coming summer. This road is to be built by the Government as one of the main branches of trunk roads leading from the United States through the eastern townships to Montreal and Quebec. It will provide a direct route from Portland, Boston, and practically all the New England States into the most interesting and picturesque portion of Canada.

Emerson is the centre of a newly-organized good roads district in Manitoba. The movement is expected to receive quite an impetus from split-log drag competitions, which are to be instituted. It is expected that later on another district, with Morris as its centre, will be organized. When this has been accomplished a splendid road all the way from Winnipeg to Emerson may be anticipated.

The Dominion Sheet Metal Company, Limited, capitalized at $300,000, have purchased a 4½-acre site at Hamilton, Ont., for the erection of a new factory. At the outset employment will be given at about 100 people, and the output will be 15,000 tons.

The Selection of Asphaltic Materials for Road Construction*

By Alfred A. Berkowitz

TO specify an asphalt by its chemical or its physical properties alone is not enough. The chemical properties of two asphalts might be the same, while physically they differed markedly Moreover, a relationship exists among certain properties, and there is danger of assigning limitations to the several properties covered in a given specification without considering the effect of each limitation upon the other properties included. For instance, the higher the ductility required of an asphalt the more susceptible it is to change in temperature.

Furthermore, the engineer cannot be governed entirely by theoretical considerations, but must keep in mind the ability of the manufacturers to meet his requirements. Instances can be cited where the combinations of properties required have not existed in any commercial material. These impossible requirements usually result when the engineer selects clauses here and there from several other specifications which he knows have given satisfaction.

With a view to remedying this evil, the American Society of Civil Engineers, the American Society for Testing Materials, etc., have prepared standard specifications for asphaltic materials in various kinds of road construction. These specifications are very well drawn up and serve their purpose admirably, provided they are correctly and intelligently used. It is in this regard that experience can help us. In cases where these specifications have been used, nearly all the failures have been due to the fact that the specifications were followed blindly, without an understanding of their value and their interpretation; merely, as it were, substituting in a formula without considering the units involved.

A knowledge of the value and interpretation of each test must be possessed by every engineer who makes or who uses specifications before he can hope to obtain success in the employment of these very desirable materials. This is, in fact, the chief lesson of experience. Then, knowing these facts, and keeping in mind the lessons of service tests of similar materials under similar conditions, the engineer can employ specifications with the assurance that his work will be a success.

The value and interpretation of the more important tests required of asphaltic materials will be discussed.

The individual tests usually specified may be divided into three groups: (1) They may directly indicate the suitability of the material specified for a given use; (2) they may serve as a means of identifying the material or its source, and (3) they may serve to control uniformity in the preparation or manufacture of a material.

Suitability

The most important test belonging to the first group is the determination of the consistency or viscosity. The consistency or viscosity of a material is its degree of firmness as determined by measuring its internal friction. Requiring this test in the specifications is of value, since a physical test can generally be better understood than any corresponding chemical one. This test, however, can be of maximum value only when applied to a specific type of asphaltic material and when considered in connection with other tests which by themselves may not directly indicate suitability. Thus for one type of bituminous concrete pavement the proper penetration at 25 degrees C. for a California asphalt may be between 7 and 9 mm., while the proper penetration limits for a fluxed Bermudez asphalt to be used in exactly the same type of pavement and under the same conditions may be from 14 to 16 mm. Again, experience has shown that a harder asphalt cement is needed for a sheet asphalt pavement of sand, powdered limestone and asphalt cement than for a pavement containing crushed stone. The amount of traffic and the climate are also important factors to be considered in fixing penetration limits for any asphaltic material.

Another test serving to indicate the suitability of a material for any special purpose is the volatilization test. A determination is made of the loss in weight of the material by volatilization, and of the consistency of the residue. It is of considerable value when applied to road oils. The loss in weight thus found is a fair indication of the loss by volatilization suffered by the material in the course of time when applied to the road, and also the character of the residue is similar to that eventually left in the road. The residue should be of a sticky nature. If the residues of these oils are not sticky and adhesive they will produce an undesirable surface in wet weather. A paraffin oil will produce a greasy residue, and is, consequently, worthless for road work, whereas an asphaltic oil may be successfully used for this purpose.

Identification of Source of Asphalt

The more important tests serving as a means of identifying the source of a material or even the material itself, are the specific gravity, melting point, solubility in carbon disulphide and fixed carbon determinations. The specific gravity of an asphaltic material is one of the most important characteristics used to determine its identity. This is especially true if its specific gravity is considered in connection with the consistency of the material, and sometimes its solubility in carbon disulphide. Thus a bituminous material with a specific gravity of 0.99 and a penetration of 7 mm. at 25 degrees C. is a blown product. Fluid consistency and a high specific gravity of 1.25 in a tar serves to identify it as a coal tar, and the identity is strengthened if its solubility in carbon disulphide is as low as 75 per cent. As applied to oil and oil products, the specific gravity roughly indicates the amount of heavy hydro-carbons which give body to the material. As a rule, paraffin oils have the lowest specific gravity and are of no value for road work, whereas asphaltic oils have the highest specific gravity and are most desirable for this purpose. In regard to solid bitumens as originally found, it must be remembered that the specific gravity will depend largely upon the per cent. of mineral matter. Thus the specific gravity of Trinidad asphalt (containing 37 per cent. of mineral matter) is 1.40, while Gilsonite, an extremely pure native bitumen, has specific gravity of 1.04.

The melting point of a bitumen is directly related to its hardness and brittleness, but the relations for all classes are not the same. The method of employing the material must also be considered in connection with its melting point. If the penetration method is used, the melting point should not be too high, because the highly heated material would be solidified by the cold stone before it had penetrated to any extent. In a bituminous concrete pavement, the melting point may be as high as climatic conditions will allow.

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* Extract of a prize essay submitted in a recent competition instituted by the Barber Asphalt Paving Company.

The determination of the solubility in carbon disulphide of an asphaltic material enables the amount and character of the contained bitumen to be ascertained. The percentage of bitumen thus obtained does not alone determine the value of an asphalt for paving purposes. Two asphalts might contain the same amounts of bitumen and yet possess entirely different powers of resistance to the destructive action of the elements. One might possess stability, the other not. The character of the bitumen does, however, indicate, by the amount of mineral matter present, whether an asphalt has been used. Likewise, an absence of mineral matter indicates that the material has been destructively distilled during its preparation.

The amount of fixed carbon in asphaltic material also serves to identify the source of a material. Thus high fixed carbon in most asphaltic cements produced from Mexican petroleums serves to differentiate them from asphalt cements of the same consistency produced from California petroleum. Consequently, if the amount of fixed carbon found in a California asphalt cement were as high as the amount usually present in Mexican asphalts (about 16 per cent.), the indication would be that it has been injured by overheating.

Control of Preparation and Manufacture

The tests that serve to control the preparation and manufacture of a bituminous material are the flash point, distillation, and the solubility in naphtha tests. The temperature at which the material flashes is an indication of the treatment to which it has been subjected. Crude oils have a low flash point, while more highly distilled products have correspondingly higher flash points. The flash point of a material must be considered in connection with its proposed use. If the material, especially a heavy road oil, is to be heated before application, the flash point should be high enough to prevent its ignition while being heated.

The distillation test is a valuable one, especially for tars. No tar containing water should be employed as a permanent binder.

The extent of the solubility in naphtha is an indication of the amount of body-forming hydro-carbons which give mechanical stability to the material. No oil containing less than 4 per cent. of bitumen insoluble in naphtha will prove of service other than as a dust preventive.

To the valuable data that may be obtained in the manner described above must be added the lessons of experience and service tests of various asphaltic materials under various conditions and in different types of roads and pavements.

The need of alleviating the dust nuisance has involved the use of asphaltic oils for that purpose. Experience has shown that the oils used should show some degree of adhesiveness when rubbed between the fingers. Their residues after the evaporation test should be decidedly sticky. If oily, they will act more as lubricants than as dust binders.

It must be emphasized again that paraffin oils are worthless for this purpose. Engineers throughout the country are finding that the use of palliatives for dust prevention is but a makeshift at the most, and that the best practice is tending toward the construction of bituminous surfaces or carpet coats wherever any degree of satisfaction and permanency is desired.

Value of Bituminous Surfaces

Bituminous surfaces are used principally on macadam and gravel roads, on bituminous and cement concrete pavements, and to some extent on brick and stone pavements.

The character of the traffic to which the road is to be subjected should be considered in the construction of a surface. Experience has shown that if the road is subjected to light motor and light team traffic only, with the motor vehicles predominating, an asphaltic oil of such viscosity that it requires heating to at least 250 degrees F. before application forms a bituminous surface that withstands the traffic and thoroughly preserves the road for a period of time depending upon the quality of the material and workmanship and upon the quantity of traffic.

The failure of many bituminous surfaces can be traced to improper preparation of the broken stone surface.

The adhesion of the oils to the stone is a very essential point to consider. Most engineers are in favor of applyng the bituminous material under pressure, since the adhesion to the stone is much more satisfactory in this case. In order to get the best adhesion of asphaltic oils, the stone surface should be a little moist rather than extremely dry, but in either case every particle of dust and dirt should be removed from the stone by sweeping.

With proper construction and under normal traffic conditions retreatment is necessary every one or two years. In choosing the bituminous material for a surface which will have to be renewed often, experience has shown that care must be taken to select a material which will set up sufficiently to allow the application of repeated layers without producing a plastic, easily-moved blanket surface.

With the advent of the motor car, it was found that the water-bound macadam pavement did not stand the automobile traffic and that bituminous macadam could be laid to withstand this traffic at a cost equal to water-bound macadam, when the maintenance of the latter is considered. The bituminous material used may be either asphaltic cement or refined coal tar. The former is preferable because it possesses greater stability under atmospheric action.

Here again, numerous instances can be found where unsuitable materials have been employed through the failure of the engineer to understand the physical and chemical properties of the different types of asphaltic materials and the different methods of treating them. For example, many a good asphalt has been ruined by overheating. Again, asphalts of too little ductility have been chosen.

The slight displacement of the mineral aggregate of a pavement due to the shocks of hoofs or wheels makes it necessary that the asphalt cementing material should yield and stretch a little and not break. On the other hand, the greater the ductility, the more susceptible is the asphaltic material to changes in temperature. Once more a knowledge of the relationship between the various properties of a material enables the engineer to intelligently set the limits in his specifications.

Experimental Sections of Road

A series of experimental sections was constructed on a road subjected to mixed traffic of about 100 horse-drawn vehicles and from 250 to 300 motor cars per day. These sections were constructed with asphalt, refined water gas and coal tars, and combinations of refined coal tars and asphalts, in the form of bituminous concrete pavements, using the same material for the cement and the seal coat. Upon examination after three years, it was found that for this class of traffic, or for horse-drawn traffic exclusively, the seal coat should consist of an asphalt, as being more durable and economical than the other materials.

Experience in another locality has shown that an excess of flux or of the voltaile constituents in asphalt cements has been a cause of failure. Pavements constructed with such materials are wavy and distorted by heavy traffic.

One of the most widely used pavements is sheet asphalt. Trinidad asphalt was for many years the only available supply of such material, but in recent times many other sources have been disclosed.

In addition to the native asphalts, like those obtained from Trinidad and Bermudez, asphalts are obtained by refining asphaltic oils. The results of experience and service tests in this kind of pavement alone furnish the engineer with a collection of valuable data. The selection of both the aggregate and the asphalt cement requires a careful understanding of the climate, traffic and other conditions. Proper drainage in this, as in all other pavements, is a primary requisite. Furthermore, certain bitumens require more skill in handling than others. Again, some require particular fluxing agents and result in failures when improper ones are used.

Requirements of Asphalt Pavements

The main requisite of a good sheet asphalt pavement is inherent stability. This can only be obtained if the mineral aggregate is properly selected and if the bitumen possesses cementing value. Experience has shown that the heavier the traffic to which the pavement will be subjected, the finer must be the particles composing the mineral aggregate. In addition, the consistency of the asphalt cement must be of the right degree, that is, the newly-laid pavement should not be too hard. The marking up of a pavement by the caulks on horses' shoes does not necessarily indicate that the pavement has been improperly constructed. If the pavement were too hard at the start it would have a shorter life than if a softer asphalt cement had been used.

Sheet asphalt pavements properly constructed with native asphalts, either from Trinidad or Bermudez, have given the highest degree of satisfaction. In New York City there are 184,290 square yards of Trinidad sheet asphalt twenty years old or older. A part of this is on Fifth Avenue and is subjected to the very heaviest traffic. The remainder is also subjected to heavy travel, yet all the pavements are in good condition at the present time. Washington, D.C., has more than 1,000,000 square yards of Trinidad sheet asphalt pavement laid between 1877 and 1901. The average cost of maintenance is 1.8c. per square yard per year.

The use of hydrated lime in concrete is discussed by H. L. Bowlby, State highway engineer of Oregon, in his recent annual report. He states the advantages accruing as follows: "The value of the lime lies to a small extent in the fineness of the particles serving as a filler, and in the main in its lubricating properties. It is noticeable that concrete containing hydrated lime slips and flows into place much easier and forms a denser mix with less tamping than that which does not contain lime. When lime is added, a less amount of water gives a greater plasticity, and therefore less danger of separation of the aggregates. Moreover, it is thought that the lime tends to hold moisture in the concrete until the setting has passed that stage where loss of its water due to absorption from the ground below can affect it." The Oregon practice is to add hydrated lime to each batch in quantities varying from 5 to 10 per cent. of the weight of the cement.

A Church Built of Fossil Stone

IN the State of New York is a unique stone quarry. When the stone was first quarried it had a tendency to crumble and it was thought it would be useless for building purposes. Exposure to the sun and wind hardened it, almost like flint, and it acquired a solidity and toughness unsurpassed by the hardest granite. A close examination showed it to be composed of fossil vegetable fibres, petrified cedar leaves, branches, twigs, broken bark and stumps all consolidated into one homogeneous whole.

The theory is that as those parts of cedar trees, the growth of an unknown past, fell one layer upon another in the depths, once the bed of a prehistoric lake, they were saturated with the dampness of the swamp and with the lime held in solution. As the vegetable matter decayed and the water evaporated every line, fibre and grain was preserved by the lime sediment, in time to become limestone of exceptional hardness. There is a church at Mumford built of this stone, and a stranger glancing at the walls would regard them as having been constructed of rough sandstone, smeared with an uneven coating of gritty, coarse plaster, but from a closer view he would see, instead of plaster, traceries of delicate leaves, bits of broken branches, fragments of mossy bark, splinters of wood, every block of stone in the four walls a closely cemented mass of dainty fossils, an exhibition of prehistoric vegetation standing forth in bold relief as imperishable stone.

Dead vs. Live Air-Space

Where a wall is built of hollow concrete blocks, or of two monolithic walls with intervening air-space, the question arises as to whether the air-space should be closed at top and bottom and thus rendered "dead," or should be ventilated and kept "live" by means of outside openings, allowing a certain amount of free circulation of the air inclosed within the wall. If it is desired to keep out frosting and dampness, to prevent condensation on inner walls, to check absorption of heat and preserve equable temperature, the air-space should be sealed and kept "dead," as only in this way can the best degree of insulation be secured. If openings are placed or allowed in the walls, the result aimed at will be lost—namely, the exclusion of frost and dampness. Generally speaking, the narrower the air-space, the better. An air-space wall—provided the blocks or poured concrete are of the proper quality of ingredients, proper proportions of mix, and properly placed—should give no trouble from frost or dampness.

European and American Practice in the Handling of Sewage Sludge[*]

By Geo. S. Webster[†]

THE most serious part of the problem of sewage disposal is the handling of the sludge which results from every known method of treatment. It is possible that in the future, in order to meet higher standards of hygiene and cleanliness, methods may be devised for intercepting sewage solids as near their place of origin as possible and before they have become offensive, and also to recover practically all of their ingredients which have value prior to their breaking up and in part entering into solution. But no practical methods of accomplishing these ends are yet known.

One of the difficulties of handling sludge is the enormous quantities produced. London, with a population of six million tributory to the sludge works, produces by chemical precipitation 2,597,000 tons per annum of wet sludge of 92 per cent. moisture. The district of Birmingham, England, with a population of 950,000, treats and disposes of 427,000 tons per annum of wet sludge of 94.5 per cent. moisture. Experience with sewage works indicates that on the average 1,000 persons produce 45 tons of dry sludge matter per annum. If this were deposited in tanks as sludge containing 90 per cent. moisture it would make 524 cubic yards.

One of the most important considerations in handling sludge is the percentage of moisture which it contains, as this determines its bulk. Of the dry residue in sludge, approximately one-half is organic and one-half mineral. A large part of the organic matter in freshly deposited sludge is highly putrescible, and if improperly handled produces offensive odors.

The final disposal of sludge is accomplished by (a) discharge of wet sludge in the sea; (b) depositing wet sludge on land; (c) the use of partly dried sludge for filling in low waste lands and where circumstances warrant; and (d) the use of sludge as a fertilizer, fertilizer base or as fuel. The first method is practicable for large cities located near the ocean. Sludge from the sewage of London, England, is collected on the Thames about twelve miles below London Bridge and allowed to settle until it contains about 92 per cent. moisture, when it is pumped into six tank steamers which transport it 55 miles to deep water in the open sea; an average of 8,300 tons of sludge being thus disposed of every week day at a cost of 9 cents per ton. At Manchester, England, the sludge from septic tanks is carried by a tank steamer to the open sea, 215,082 tons of wet sludge having been so disposed of last year at a cost of about 15 cents a ton. Other large cities disposing of wet sludge in this way are Glasgow, Scotland, Salford, England, and Dublin, Ireland.

Depositing Wet Sludge on Land

The disposal of wet sludge without prior dewatering may be accomplished by its application to land in several ways. The earliest method used was called lagooning in which case earth embankments were built enclosing an area of suitable land and the wet sludge run into a depth of as great as 10 ft. The clogging of the soil preventing free drainage of the moisture; the scum formation upon the surface retarding evaporation, and the frequent great depth of the sludge, all tend to prevent the sludge from drying. As an example, there are sludge lagoons at Birmingham, in which the sludge deposited many years ago is practically in the same condition as shortly after being placed except that a heavy crust has formed upon the surface. This method is rapidly being abandoned.

To overcome these objections and to dispose of the sludge more quickly, it was run upon the surface of farm land to form a shallow layer which would dry in a reasonable time and could then be plowed in and the field cultivated. But the gross nuisance created by the exposure of such large areas of foul smelling sludge led to the adoption of what is called trenching. As practiced in Birmingham, England, the trenches were dug about 3 ft. wide and 18 in. below the surface of the soil, the excavated earth forming banks between the trenches so that they can be filled to a depth of from 24 to 30 in. with wet sludge, after which the tops of the earth banks are thrown over the sludge to prevent nuisance from smell or flies. The porous earth absorbs the moisture and later the land is plowed across the trenches and placed under cultivation. This process can be repeated at intervals of from eighteen months to two years.

The cost of trenching at Birmingham amounted to about 8 cents per ton of wet sludge. This is exclusive of the cost of sludging tanks, but includes interest on capital outlay at 5 per cent. and rent of land. This method is not being used in new plants and is being abandoned in old plants on account of the area required, the interference which is caused in times of heavy storms, the increased difficulty of operating caused by winter weather and the general cumbersomeness of the method.

Mechanical Processes for Dewatering Sludge

Among the early mechanical methods of reducing the bulk of the wet sludge by dewatering was pressing in machines which consist of a number of cast-iron plates generally 9 sq. ft. in area with corrugated faces and surrounded by a machined rim so that when placed together they form watertight cells 2 in. thick. A central pipe about 6 in. in diameter extends through the middle. Over each plate a canvas cloth is placed and sludge forced into the press and subjected to a pressure of from 60 to 75 lbs. per sq. in. This squeezes the water out and the resultant cake contains between 50 and 65 per cent. moisture and is about one-fifth the bulk of the original wet sludge.

It is necessary to add to the sludge before pressing from ½ to 1 per cent. of lime, the fine particles of which facilitate the passage of water, the dissolved lime agglomerating the solids of the sludge. The cost of sludge pressing largely depends on the amount of lime added, the kind of sludge pressed and the magnitude of the works; in large cities the average cost is 10 cents per ton of wet sludge.

At Worcester, Mass., about 18,000,000 gal. of sewage a day is received at the chemical precipitation works. There are added 55.5 lb. of lime to each 1,000 gal. of sludge, which contains on an average about 90 per cent. moisture when pumped from the tanks. The presses reduce the moisture to about 70 per cent. and

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[*] Abstract of a paper delivered before the American Society of Mechanical Engineers.

[†] Chief Engineer, Bureau of Surveys, Philadelphia.

0.167 tons of sludge cake are obtained from each cubic yard of the wet sludge. The pressed cake is hauled in electrically propelled cars about a mile and disposed of for filling low waste land.

Another mechanical method of dewatering sludge is by means of centrifuges which occupy less space than presses and do not require the addition of lime to the sludge. Such machines are continuous in action and the work of extracting the moisture consists of two distinct and constantly repeated periods. During the first period the wet sludge is introduced into the machine and by the action of centrifugal force the moisture content reduced. During the second period the sludge thus partly dried is automatically ejected. The final product contains about 60 per cent. moisture and occupies about one-eighth the volume of the wet sludge.

The largest installation of these machines is in Frankfort-on-Maine, Germany, where the sewage of 400,000 people is subjected to plain sedimentation and about 310 tons of wet sludge 90 per cent. moisture obtained per diem. The sludge is pumped to overhead reservoirs and kept agitated by revolving paddles. From there the sludge is fed to eight centrifugal driers capable of handling 325 cu. yd. of wet sludge a day of ten hours. The dried sludge is carried by a conveyor through a tunnel heated by the exhaust gases from the power station and, as a 20 per cent. moisture mass resembling soft coal of a gray color, is mixed with garbage and both disposed of by destructors, the steam being used for generating electricity for power and lighting.

Digestion of Sludge

In the methods of sludge handling above described efforts were directed toward preventing the dissemination of the foul odors from the wet mass. Within recent years much thought has been given to devise processes of treatment by the digestion of the putrescible matters to produce an inoffensive sludge both as withdrawn from the tanks and during drying.

One of the methods to accomplish this purpose is to remove the freshly deposited sludge from the sewage sedimentation tanks at intervals and place it in separate tanks. Usually a scum forms upon the surface, beneath which more or less active fermentation and decomposition develops. New sludge is added and digested sludge withdrawn from time to time and the latter placed upon underdrained sand or cinder beds for drying. On account of the digestion of the sludge it dries more rapidly and is much less offensive than fresh sludge.

This method of sludge handling is now in use at Baltimore, Md., where the sewage is freed of its settleable solids in large tanks. The accumulated sludge is removed at intervals by centrifugal pumps discharged into adjacent concrete tanks where considerable digestion occurs as indicated by the continuous ebullition of gas, which is inoffensive. At first the sludge was withdrawn from the digestion tanks and dried upon underdrained sand beds. It could be removed in a much shorter time than undigested sludge and but little offense was created. At the present time, the wet sludge from the digestion tanks is being sold to farmers for use on truck farms. The same method of separate sludge digestion is in use at Birmingham, England, the dried material being used to fill in a deep ravine between railway fills.

For the last twenty years it has been known that the retention of sludge in the tank in which it is deposited, which is known as the septic treatment of sewage, resulted in the reduction of the bulk and offensiveness of the sludge, but experience showed that while the sludge was benefited, the water leaving the tank, known as the effluent, was seriously fouled by the decomposition of the organic matter in the sludge. The first attempt to obviate this fouling of the effluent was the digestion of the sludge in a separate tank above described. Another attempt was made by Dr. Travis at Hampton, England, who built a septic tank divided into upper and lower compartments; four-fifths of the sewage was passed through the upper part and the sludge settled through slots into the lower part through which the remaining one-fifth of the sewage flowed. Thus four-fifths of the sewage remained fresh but when the foully contaminated one-fifth was added to the tank effluent it frustrated the purpose. Furthermore, the passage of sewage through the lower part maintained conditions favorable to the development of sulphur bacteria and produced a malodorous sludge.

The separation of the digesting sludge from the settling sewage was adopted by Dr. Imhoff of Essen, Germany, in the two-storey tanks known as Emscher or Imhoff tanks. Their extensive introduction in Germany and America is due to the fact that when properly operated they efficiently free the sewage of its settleable solids, yield a fresh inodorous effluent, produce sludge that is inodorous, of low water content and consequent small bulk, and which dries more quickly than any other kind of sewage sludge.

In normal weather, sludge from a matured Emscher tank will dry on sand beds in from three to five days to a consistency fit to remove, while sludge from septic tanks requires at least two weeks' time, and sludge from plain sedimentation tanks will require about eight weeks in summer and at least twice that length of time in winter, to be dry and firm enough to handle.

Dried Emscher sludge is suitable for filling low land or use in agriculture, particularly in lightening heavy soils, as it is very spongy in texture due to the entrained gas. But experience has demonstrated that the use of air-dried sludge from any source will not give results comparable with those obtained from the use of artificial fertilizers.

The rapid drying of sludge digested in Emscher tanks allows of very much smaller sand beds than for other kinds of sludge; in fact, it is usual to provide only 1 sq. ft. of bed for each three persons tributary to the tank.

The Recovery from Sludge of Ingredients Which May Have Value

Sludge contains ammonia, phosphoric acid, potash, grease and carbon. Generally speaking these ingredients are more costly to recover than they are worth. It has been estimated that the manurial value of excreta of one person in a year is $2.62, but in the dilute sewage of America this would be contained in about 36,000 gal. of water. If this material is deposited as sludge of 90 per cent. moisture it would weigh about 1,720 lbs. per cu. yd., and each cubic yard would contain only about 80 lbs. of organic matter, of which only a part has any monetary value.

The problem of recovering the valuable ingredients in sewage sludge, therefore, involves the use of economical and efficient processes for drying or pressing to reduce the bulk of transportation; also in order to recover the grease in sewage with present methods, it is necessary to have the sludge in a very dry condition.

Dr. MacLean Wilson, chief inspector of the West

Riding of Yorkshire Rivers Board, believes that the valuable ingredients of sewage will ultimately be extracted and utilized, since many capable experimenters are at work upon this problem. H. W. Clark, chemist of the Massachusetts State Board of Health, considers that sludge has some value, and that it seems inevitable that, as the processes of drying, pressing and fat separation are improved and as nitrogen advances in price, sewage sludge will become of greater agricultural value than at present; especially as a base for fertilizer, to be enriched by the addition of potash, phosphates, etc.

At Bradford, the centre of the wool industry in England, large quantities of wool washing waters enter the sewers, amounting to one-tenth of the total sewage. These waters contain large amounts of grease, which is recovered by treating the sewage with sulphuric acid and heating it to 212 degrees, then pressing it hot. Most of the grease comes out in the hot press liquor, which is then boiled with chemicals and the grease separated, and sold at from $35 to $50.50 per ton. Excluding certain fixed charges, it is claimed that the grease is recovered in this way at a profit.

Enlargement of the sludge handling capacity of the Birmingham sewage works is contemplated by installing what is known as the Dickson process, as employed at Dublin. This is described as follows:

> In this method of handling sludge about 0.5 per cent. of yeast is added to the sludge as removed from the tanks and the mixture pumped through a heater which consists in a number of pipes placed in the path of the hot air from the furnace to fermenting troughs in the bottom of which are hot air ducts to keep the fermenting sludge at about 90 degrees Fahrenheit. In 24 hours, as a result of the fermentation, there is a distinct separation of water, the sludge at a density of about 83 per cent. occupying the surface while the water can be readily drained away beneath. A compound of phosphates and potash in about equal proportions by weight of sludge and compound based on dry solid matter is then added and the mixture containing about 73 per cent. water is then pumped to the dryer, which consists of a cylindrical vertical casing containing a series of arms and platforms revolving upon a central shaft and between fixed arms and platforms. Air at a temperature of about 450 degrees Fahrenheit is blown into the dryer at the bottom and passes out the top. The dried mixture falls into a disintegrator which beats it up into a powder, which would be used as fertilizer.

Experiments made in the Philadelphia sewage testing station in burning dried sludge or wet sludge mixed with fine coal confirm the accepted conclusion that it is not practicable to recover completely the calorific value of the sludge in actual amounts of water evaporated by burning it. Where sewage works are near refuse disposal plants, however, the sewage sludge may sometimes be burned with the refuse, as is done at Frankfort-on-Main, Germany. At Over-Schoneweide, near Berlin, layers of sludge of 60 per cent. moisture and culm or dust of brown coal are run into a gas producer and utilized to run a 60-horsepower gas motor generating electric energy, which is used for power and for lighting the plant and adjacent streets. If all power could be sold at 2½ cents per kw.h., this process would show a profit of 50 per cent. on the net cost of production, exclusive of interest on invested capital. No nuisance whatever seems to be created by the plant. In Potsdam, also near Berlin, brown coal and sludge are mixed in the proportion of one coal to eight sludge in the sedimentation process, 150 grams of sulphate of iron per cubic meter of sewage being added also. These assist in the precipitation, and the mixture of sludge and coal is pressed into briquettes of 60 per cent. moisture having a heat value of 1,500 units. These briquettes are the only fuel used in a city electric plant in an adjoining building. It is said that the cost of briquetting about equals the value of the electric energy. Experiments are being made at Birmingham, England, to utilize air-dried sludge by burning it in specially constructed furnaces, thus obtaining heat for the separate digestion of about one-sixth of the wet sludge by the new yeast fermentation process previously mentioned.

Fastening Studding in Concrete

A method of fastening wood studding directly to concrete foundation walls consists in the use of an embedded metal socket in which the studding is inserted. These studding sockets are made of cast iron, and there are several types of them on the market. They are, however, a comparatively recent invention, but have won recognition on their merits, as they eliminate all the old-time troubles connected with this detail of making a durable and firm connection in framing wooden members into concrete walls.

The old method of bolting a sill to the wall, in the construction of a corn-crib, for example, has not proven a thorough success, in that as soon as the sill decays or rots—which does not take long—the whole side wall of the crib can be seen to be bulging outward and spilling its golden treasures over the surrounding ground.

These sockets are set into the green, soft concrete when the wall is being laid. They have long claws so that they firmly grip into the concrete, with the result that one has a permanent post support. The ends of the studding will not decay when set into these sockets, as provision is made so that any moisture which collects can drain out of the bottom of the socket. A nail-hole in the casting makes it possible to spike the studding securely in place.

This method has solved, to a great extent, one of the greatest problems in the construction of concrete floors and foundations for farm buildings.

At the road convention in Toronto last week, models of the world's most famous roads were shown by the Ontario Government. Included in these were the Appian Way, and a standard Roman road. For thoroughness of construction these roads have never been equalled. The Appian Way is travelled on to the present day, the surface pavement only lacking repair. It was built about 300 B.C.

Skylight glass that will not drip water is the result of a new and practical application of an old, familiar scientific principle—capillary attraction. The glass is designed for skylights in factories, museums, operating rooms, or other locations where a drop of water condensing on the skylight and falling off might do much damage. The glass is ribbed with eight ribs to the inch; and the form, as well as the spacing of the ribs, is designed to make the greatest possible use of capillary attraction. A drop of water condensing on the glass is held there strongly. A very slight slope of the skylight will make the drop slide off slowly on one side into a gutter; and accordingly the glass is installed with such a slope.

Mainly Constructional

East and West From Coast to Coast

With a capital of $20,000, Gran-Nite Stone Products, Limited, have been incorporated at Edmonton, Alta.

During the last five years in the city of Regina, eighty industrial buildings have been erected at an average cost of $25,000.

Applications for the post of City Engineer of Sarnia are being received by the City Clerk, Mr. James D. Stewart, until April 8th next.

At Halifax, N.S., the Halifax Building Company has been formed out of a new partnership between A. W. and J. F. Gilroy, and J. K. Hunter.

A new Montreal concern is the Elite Construction and Supply Company, Limited, capitalized at $50,000. The incorporators are L. Doyon, F. Malone, D. Turner, G. Gordon and A. McGovern, all of Montreal.

Mr. James Brodie, Graniteville, P.Q., and James Brodie & Son, Iberville, P.Q., dealers in Stanstead granite, paving blocks, and curbing, have opened offices in the Southam Building, 128 Bleury Street, Montreal, under the management of Mr. Robert Brodie.

The city of Edmonton has shipped in two car-loads of asphaltum from Athabasca and Fort McMurray in northern Alberta. Experimental work will be done with this material, and if it is found satisfactory it will replace the asphalt which is being imported from Trinidad and elsewhere.

It is of interest to note that the City Council of Victoria, B.C., have now completed their arrangements with the Provincial Government for the erection of a new bridge in that city at a cost of $750,000. The plans have been approved, and a by-law is to be submitted to the ratepayers.

Exterior work is advancing satisfactorily on the new Commercial High School which is being erected at Shaw and Dewson Streets, Toronto, for the Board of Education by Messrs. R. Robertson and Sons, Limited. The walls are now up two floors. The estimated cost of the building is $260,000.

The city of Edmonton, Alberta, has stock yards—estimated to cost $500,000—in prospect. The project is being fathered by a stock company, in which Alderman Picard is interested. If satisfactory arrangements can be made with the city, the company will have the yards in operation by September 1.

Good progress is being made on the Post Office and Customs House which is being erected at Three Rivers, Que., at a cost of $225,000. The contractors, Messrs. Verrette and Company, have the walls up to the second storey. The architect, who is superintending the work, is Mr. Charles Laford, of Three Rivers.

Arrangements have been completed for a Pan-American Road Congress to be held at the Panama Pacific International Exposition. Plans for the forthcoming Congress will be handled by an executive committee of five, of whom Major Crosby (one of the speakers at Toronto last week), Consulting Engineer of Baltimore, is one.

At Toronto, the steel frame-work for the new Registry Office on Elizabeth Street has been completed. The building, which is to cost $400,000, is to be of two storeys, with basement, the dimensions being 165 x 135 ft. The architect is Mr. C. S. Cobb, of Toronto, and the contractors for the masonry are Messrs. J. A. Wickett, Limited.

A syndicate of English and Belgian capitalists have under contemplation the erection of two large buildings in the north end of Montreal. One will be a business block, with stores, a large auditorium, and apartments in the upper portion; the other will be a purely residential building, open on three sides, and with a garden in the centre. The estimated cost is $800,000. Mr. Clarence I. de Sola will have charge of the scheme.

Among the noteworthy recent announcements of projected work is that relating to the Whitney Memorial Driveway. The idea, which is promoted by the Provincial Government and the city of Ottawa, is to perpetuate the memory of the late Sir James Whitney by building a road from Ottawa, through Williamsburg township, to the St. Lawrence River, at an estimated cost of $450,000. Plans are being prepared by Mr. J. Hilliard, of Ottawa.

The Montreal Board of Control have voted $3,030,000 for public works, in which the following amounts are included: Paving, $1,361,837; sidewalks, $337,355; water department, $242,445; re-grading of certain streets, $300,000; markets, $348,500; parks, $37,777; playgrounds, $14,500; incineration, $130,000; municipal buildings, $70,290; hospital for consumptives, $125,000. Of the $242,000 for the water department, half is to be used for laying water pipes; while an additional electric pump is to be bought for the high level station.

At a meeting of the Ontario Legislature in Toronto last week, the Hamilton highway bill was amended in an important particular. The original road allowance was fixed at 66 feet, and in the committee it was proposed that this be increased to 100 feet—a proposition that raised objections from the rural representatives. The Government has since decided upon a middle course. The Commission, if it desires to increase the width of the highway, may apply to the Ontario Railway and Municipal Board, which, after notifying the municipalities interested, will hear arguments for and against and pass upon the objections. The clause is designed chiefly to meet cases where widening is necessary to make the road safer, and is not intended to open the way for turning the highway into a boulevard. The engineering end is also taken care of in another amendment giving the railway board power to pass upon applications for widening. This is designed to meet cases where a grade through big cuts makes it necessary to have a wide road allowance in order to slope the banks on either side.

The estimated cost of raising the level of the St. Lawrence river by a system of retaining dykes and the damning of subsidiary channels is placed at $487,000 by a Government commission, whose report—prepared by E. E. Haskell, of Cornell University, V. W. Forneret, superintending engineer of the St. Lawrence River Channel, and W. J. Stewart, hydrographer—has just been received. The detailed estimate is as follows: rock filled dam, No. 3, Chenal du Castor (between Ile Castor and Ile du Pads), $25,322; rock-filled dam, No. 4, Chenal du Pads (between Isle du Pads and Ile St. Ignace), $16,135; rock-filled dam, No. 5, Chenal Aux Ours (between Ile Madame and Ile aux Ours), $13,107; rock-filled dam, No. 7, Chenal Corbeaux (between Ile du Grace and Stone Island), $23,222; rock-filled dam, No. 9, Chenal des Barques (between Ile aux Barques and Ile au Moins), $63,870; rock-filled dam, at Pointe du Lac, at foot of Lake St. Peter, $141,960; rock-filled dam, at Repentigny, between Ile a Bague and Ile Bellegarde, $203,745; total, $487,361. The new plan to raise the river level will be the sixth enterprise of its kind, if undertaken. A 16-foot channel was dredged—completed 1854. Then followed the 20-foot channel three years later. In 1875 a 25-foot channel was required to meet traffic needs, and this necessitated dredging in twelve localities which carried the work on to 1882. The 27½-foot channel was the next undertaking started in 1882 and finished in 1888. In 1892 the 30-foot channel was begun and was not completed until 1906.

Improved Street Lighting

(Contributed)

DURING the last two or three years, particularly in Ontario, there have been considerable changes in the method of lighting streets, both in large cities and in the smaller towns and villages. The original plans appear to have been laid out without any regard to lighting efficiency, artistic appearance or durability. There are still scores of towns in Canada whose lighting system is entirely inadequate.

Where efficiency in the street lighting is the primary requisite, the use of a sheet steel, porcelain enamelled radial wave reflector placed in a proper location above the lamp will accomplish the result satisfactorily. In cases, however, where it is possible to sacrifice a little efficiency, it is quite desirable to diffuse the light through a suitable glass globe and thus secure a pleasing effect and prevent glare. This is especially the case with the newer types of nitrogen-filled lamps, where the source of light is extremely small, and, therefore, the intensity is considerable.

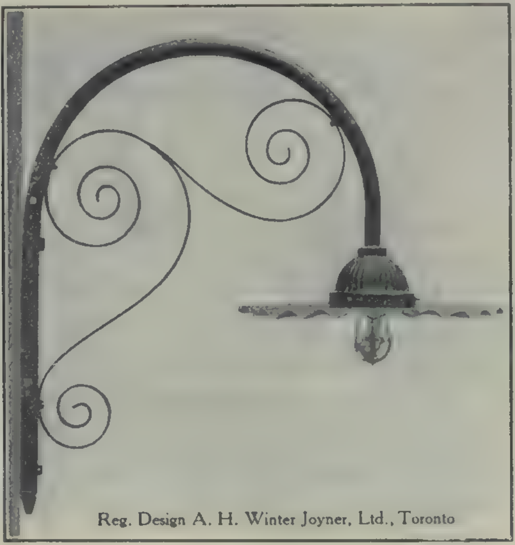

Fig. 1.

To accomplish the desired result in diffusing the light it is necessary to carefully select not only the shape, but the quality of the glassware. It must be remembered that even clear glass absorbs a few per cent. of light in transmission, and many opal glasses lose considerably over fifty per cent. The standard opalescent will lose nearly forty per cent. of the light. In these days, however, we are able to use glassware made with scientific mixtures, so that the actual loss in transmission is only a few per cent., while the diffusion secured is extremely high. Glassware of the types of alba and moonstone possess these qualities to a high degree. Recently a new glass known as Monax appears to be a still further development.

Another point to be considered about a street lighting fixture is that it should be durable and have an extremely low maintenance. There are certain portions of a fixture which must be in pipe and other wrought iron shapes to secure certain artistic effects, but as a general rule it is desirable to use cast iron with a baked enamel finish or other protection against the weather for as many exterior parts as possible—care being taken, however, that such items as thumb screws are made in bronze or so treated that they will not rust.

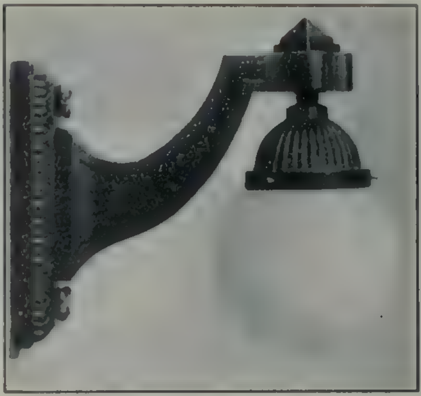

Fig. 2.

The illustrations shown in Figs. 1 and 2 have been designed on these lines.

Fig. 1 is a wrought iron bracket which supports a canopy of finely-moulded cast iron. The reflector has good illuminating lines and is so shaped as to be exceptionally strong and durable. The lamp in this form of bracket can be screened if desired, by using a globe in addition to the reflector, but while this would possibly improve the appearance, the improvement is secured at the expense of efficiency.

Fig. 2 is designed in cast iron and is suitable for mounting on poles or on flat surfaces. Such a design as this cannot be had in conjunction with a reflector, but it looks extremely neat with a 9-in. or 10-in. ball globe, and is very serviceable. Both types are constantly furnished with series or multiple fittings.

There are a number of towns using brackets somewhat similar to that shown in Fig. 1. There is an installation of several thousand at Brantford, Ont. Fig. 2 is also well known, the first and principal installation being at Paris, Ont. Both these installations were made by A. H. Winter Joyner, Limited, street lighting experts, of Toronto.

The introduction of the small nitrogen units for street lighting has again brought into prominent use the Constant Current system of supply. It is necessary to use this system with the small nitrogen units, and it has been found that even where the lamps are of such a size that they could be used on both multiple or series, the results obtained on the series system have been far more satisfactory than on the multiple. In fact, the cost of maintenance with the series system is extremely small, and the full advantage of the high efficiency of the lamp is secured; whereas, with multiple systems the life of the lamp is so short, owing to the poorer regulation, that it is extremely unlikely that any extensive multiple installations of nitrogen lamps will be made in the future.

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What Good Roads Mean to Canada

IT is strange how many people we find in a rut as regards the Good Roads movement. They have the same trouble with their mental rut as the farmers have with their mud ruts. They are stuck.

We refer to the odd man you will encounter in the course of your editorial day's march along the highway of trouble—the man who will tell you that you "have been devoting too much space lately to good roads." A gentleman of our acquaintance, usually quite mild-mannered, waxed hot the other day because he had found two issues of the paper devoted practically in their entirety to the International Road Congress at Toronto. In vain we told him of the comprehensive scope of the work and of the representative nature of this particular gathering: he was a brick manufacturer, and he wanted to have people informed all the time about bricks.

We have no apology to make for the space which we devote to good roads. We are strong in an editorial policy of doing all we can to further the movement, for it is bound up hand and foot with progress in every branch of the engineering and constructional field.

What do good roads mean to Canada? They mean connecting links between the agricultural districts and the towns, and between the towns and the cities; they mean the opening up of new districts, and provide a ready means of getting building material on to the ground at minimum cost; they mean increased prosperity for the farmer (and when the farmers are prosperous we are all prosperous!); they make it possible to build rural schools; they make for better social conditions; they enhance the attractions of rural life; they increase travel throughout the country, and encourage people in the idea of seeing their own country first. And they do much more—these are only the fundamentals.

The Good Roads movement will continue to receive a large slice of our attention. In witness whereof we publish in this issue an interesting paper by Mr. Robert A. Meeker, State Highway Engineer of New Jersey, and also a discussion of Mr. Van Scoyoc's paper, "Concrete Roads and Streets," submitted by Mr. Frank Chappell, Town Engineer of Oshawa.

The "Spec." Builder

FROM England a north country correspondent writes us to the effect that the speculative builder is becoming a consort of the dodo. This fact our correspondent deplores, on the ground that in spite of the contumely heaped upon the speculative builder by the cynics he has proved himself to be of incalculable service to the public.

In Canada, also, we hasten to reply, speculative building is more or less moribund—not altogether to our liking. A measure of decline—and an appreciable measure—was to have been expected, but from now on there can be little excuse for lack of enterprise. In Canada we are situated far more favorably than they are in England, where the capitalist, perforce, views speculative building as an uncertain industry likely to be penalized by legislation and yield poor dividends. We are told that the British capitalists are leaving the building trade alone and patronizing more favored industries—an example which Canada need not follow to the letter.

There will never come a time when sane speculation is removed entirely from the active area of business effort. There are some men in the West to-day whose faces are set so strongly against anything of the kind that they would introduce into the Litany a special plea for deliverance from the element of chance. We are inclined to the opinion that the speculative builder will come into his kingdom again, and that it will not be so long before a good proportion of the disadvantages under which he labors at present will have gone by the board.

Let us not forget that when the War is over we are going to have a bigger, brighter, and better Canada. We are going to offer a home to many thousands of the more respectable Germans (the term is comparative only, for we all know that there are no respectable Germans) who will have been liberated from the Kaiser's system of serfdom; we are going to build up greater industries; we are going to institute town and city improvement schemes; we are going to see the consummation of the great harbour development schemes at St. John, Montreal and Toronto—all of which spells activity for the speculative builder. His turn will come.

In our opinion, the next few years will witness an unprecedented demand for workmen's dwellings and the smaller type of residence. Everybody is encouraging Canadian manufacturers in the idea of capturing enemy trade and making a permanent institution of the business that has been diverted to us by the War. This is good constructive effort, and we should back it up with might and main. By pulling together for industrial expansion we are pulling together for constructional enterprise.

We want to retain the speculative builder, and every other type of builder. If we can develop our manufactures in such a way as to open up a demand for new factories, dwellings, and so on—giving the capitalist the right opportunity, we shall be getting money into circulation and building up industry. And that is what we all want.

Business and Philanthropy—A Bad Mix

WE cannot say that we are in accord with the disposition noted in some quarters to advocate the wholesale retention of skilled and unskilled workmen during the present period of depression. At a Board of Trade meeting the other day one of the members was discussing unemployment, and said **rightly** that if the country lost its industrial classes it would lose its backbone, but he said **wrongly** that from an economic point of view it was better to keep the workmen employed.

Now, had the speaker asserted that the community would be better physically and socially for constant employment he might not have been very wide of the mark, but to say that it would be better from an economic point of view is a statement which cannot be accepted unquestioningly. Where does the economic advantage come in? Is it not fair to suppose that such a policy put into effect would mean loss to the employer? If a full working staff be maintained during the period of depression we shall come to the point when both time and wages will have to be reduced to a minimum. With wages continuing, and the ordinary expenses to meet, in face of a revenue cut in two, perhaps, where is the money to be found? It is all very well for labor leaders and other philanthropists to discuss what employers should do with their men, but it must remain with the employer to obey the dictates of experience and economy. Any attempt to combine business and philanthropy—that is, any attempt on a wholesale scale—will contribute more to putting a firm out of business than any other factor.

The stability of the constructional industry will be maintained only by the application of sound business principles backed up by resourcefulness and enterprise. We are all for the "Business-as-Usual" policy; we are all concerned with the welfare of those engaged in the constructional industries; but we are not all with those who advocate impracticable methods of keeping the head of the working community above water.

Business and philanthropy are a bad mix.

Greatly Increased Acreage for Grain Production

WITHIN the next few weeks the farmers in Canada will be engaged upon the work of seeding the greatest acreage which has ever been given over to the production of grain in the history of the Dominion. While statistics portraying the actual increase in area will not be given until the federal authorities at Ottawa compile in the late spring the reports from their correspondents on work done, the findings of investigations which have already been completed point clearly to the conclusion that the additions throughout the Western provinces, at least, will be very considerable in extent. Officials of the Canadian Northern recently finished a survey of fall plowing along the lines of the company in Manitoba, Saskatchewan and Alberta. The figures which were sent in, of course, deal with the C. N. R. only, but they may be taken as an indication of the manner in which the farmers west of the Great Lakes have responded to the call for a greater production of foodstuffs in Canada. Five hundred and thirty-nine agents contributed to the report in order that it would be thoroughly representative of the territory served.

Altogether, along the Canadian Northern lines in the prairie provinces the increase may be averaged at forty per cent. The figures give a total acreage plowed last fall of 6,181,376 acres. This is an increase of 1,766,108 acres over the preceding year. Figured at 21.38 bushels to the acre—the flat average of the yield in western provinces in 1914 for wheat, oats and barley—the grain yield from fall-plowed lands along the Canadian Northern in Manitoba, Saskatchewan and Alberta would be 132,157,818.88 bushels. On the yield basis of last year the increased acreage would produce 37,759,389.04 bushels. But 1914 was an off year for grain production in the West, and that average will probably be exceeded in 1915.

"Never Put Off to the Morrow"—BUILD NOW

THERE are certain kinds of treatment which, in order to be efficacious, must be well rubbed in. We believe that this principle applies to our arguments about the desirability and wisdom of the "Build-Now" policy, and so it is that we offer a further little homily on the subject.

We take for our text this week a few points from an address delivered the other day before the Southampton (Eng.) Chamber of Commerce by Mr. E. F. Harmer, F.S.I. We are glad to do this, as it shows the wide-spread character of the "Build-Now" campaign, and removes from us any suspicion of fathering a local cry. The wise men of the East are coming forward with identically the same arguments which The Contract Record has been making from time to time during the last few months. Mr. Harmer tells us that it is a mistake to put off building until after the War, as the cost of materials will undoubtedly increase considerably then. Continuing, he mentions something significant to the constructional interest in Canada. Since January, 1915, in the Old Country, timber has increased 25 per cent. and glass 120 per cent., the increases being due to the great demand by the War Office and decreased shipments owing to the War. In the case of a dwelling costing $7,500, the increase is $300, or 4 per cent. of the whole. Taking a store costing $25,000, the increase figures out at $640, or 2½ per cent. of the whole. In the case of a large factory costing $250,000, where as little timber as possible has been used, and where, roughly, 6,000 cubic feet of timber and 57,000 superficial feet of glass are required, the increase is $4,400, or not quite one-sixth of one per cent.—this low additional cost being due to the small amount of timber used and the practically fire-proof character of the building.

Mr. Harmer examines into the conditions likely to prevail after the War. In the first place he reminds us that owing to the terrible destruction of property in Poland, Belgium, and France—to say nothing of what will happen in Germany a little later on!—immense quantities of iron, steel, cement, bricks, timber and glass will be required to rebuild not only houses and business premises but factories—because until trade is re-established in these countries there will be unemployment and want among the working classes.

This extraordinary demand is bound to affect prices all over the world, and there will be a shortage of supplies against which we should all provide. This is a home truth for Canadians as well as Englishmen, and we are glad to commend the policy of the Southampton Chamber of Commerce. No effort should be spared to induce and encourage our manufacturers to extend and rebuild or reorganize their factories before the big demand is upon us. We agree with the view that people who put off until to-morrow what they could well take in hand to-day in this line of business will have a sad awakening after the War.

The Status of the Engineer

THE need for a broader training for the engineer was pointed out by Prof. Swain, of Harvard University, in an interesting address published under the heading "Why the Engineer fails of Public Recognition" in our issue of March 10. The subject is one deserving of the studied and continuous attention of engineering societies in Canada, and it is one which we hope will be made a topic of discussion in an early issue of The Contract Record. Altogether insufficient attention has been given to a consideration of the status of the engineer as a leader in the community, and as a result he occupies about the lowest rung on the professional ladder instead of one of the highest.

In his address Prof. Swain made a plea for the exercise of individual influence in bringing to the attention of students the real facts in regard to the engineering profession, its possibilities, and the high character of its work. He suggested a broader curriculum for technical education, with more attention to fundamentals and less to technical details.

We mention these points in Prof. Swain's paper because we reproduce herewith a discussion contributed to The Engineering Record by Mr. J. Vipond Davies, who points out the narrowing influence of the constant handling of engineering details. Mr. Davies says:

"To my mind the cause of the trouble to a considerable extent goes back to the education of the engineer, and the schools are very largely responsible in too elaborate specialization in the early curriculum. The work and duty of the engineer is a devotion largely to detail, which to a large degree causes a constriction of ideas, as by the very nature of his work the engineer is drawn out of contact with other peoples and professions and naturally obtains a narrowing experience of life, which in itself is most detrimental to his general qualities for leadership.

Early Education Should Be of the Broadest Character

"If the character of a man's work in his later years is necessarily so absorbing, then the early education should be of the broadest character possible and professional specialization should not begin during the period of education. The lawyer and the doctor are continuously brought into contact with other people and other lines of endeavor and the whole after-tendency is to give breadth of view. The engineer, by the very character of his work, has not the same advantage. There is, therefore, to my mind, too much specialization, with consequent narrowing of views, in the ordinary college training.

"The colleges, too, commonly narrow their training to a single branch of the profession and will have separate schools for electrical, mechanical and civil engineering and other multitudinous branches of the profession, whereas, as a matter of fact, the underlying principles of engineering are the same in all branches and what is needed is the broadest possible education, to fit a man for later taking up whatsoever branch he desires.

"Further, it is essential that the education of the young man in the learned profession of engineering should include a considerable degree of culture, such as is obtained more commonly by the student of law or medicine. This specialization in the schools of engineering at the expense of the general education in arts and science is later hurtful to the engineer, because so often he leaves his college or school ill equipped in general education to write clear, logical reports or to direct the general administration of affairs. The place for the young engineers to obtain all this is in the colleges; and if they so specialize that they acquire little education besides the details of engineering practice and theories, it is little wonder that the young men are not properly equipped when they leave college and settle down to confining detail with the broad learning which is necessary to the development of the practising engineer.

Education in Cost of Work

"In the ordinary technical training in the colleges education is considered solely from the theoretical point of view, whereas, in the practical application, cost and value of work executed intelligently and economically are all-important factors. Economics have a large bearing on the study of all engineering work. This is seldom, if ever, taught in the colleges—possibly because the teachers themselves so seldom know anything of the value of the work.

This narrow technical college training in multitudinous branches of engineering limits seriously the horizon of the student, with the obvious result that he feels that he has been taught only one line of the engineering profession and is unable to take up any other work for the reason that his experience and knowledge have been from the beginning so restricted. The responsibility of the college in the training of the student should be broadened rather than narrowed.

Contracts and Specifications

"There are many subjects which the engineer working in his profession finds it very difficult to acquire, and which should be taught as an essential part of an engineering course. As an illustration, every practising engineer entering responsible work faces the necessity of interpreting contracts and preparing specifications which necessitate general knowledge of the principles of commercial and contract law. Every practising engineer is faced by the necessity for a clear understanding of the theories of finance and banking and such allied subjects. I doubt if any of the colleges attach sufficient importance to the teaching of such subjects. Again, it would have been most advantageous to a practising engineer to have been taught early the principles of promotion and financial arrangements of corporations.

"Leadership in the profession requires, first and foremost, the willingness and ability to take personal responsibility. To produce such men, obviously the broadest education and training of the young engineer must be adopted. This is the age of specialization in all lines, but the speculation in engineering should be postponed as long as possible during the education period for the obvious reason that, as before stated, the whole work of the engineer is in its very nature absorbing and narrowing, and takes one necessarily out of contact with those influences which would in themselves be broadening.

Young Men Misdirected

"It is an old saying in Europe that in a family of boys the eldest enters the army, the second goes into the navy and the fool goes into the Church. This is not quite applicable, but at the same time it is quite common for families to consider that any boy who shows a liking for tools, however ill fitted or equipped he may be, must be desirous of going into the engineering profession, and it is probable that, as a consequence, numbers of boys enter the profession who are quite unlikely to meet with any success. I have in my own knowledge seen a number of engineers filling more or less important administrative positions who have made ill success in the positions they have been called to fill, for one reason, if for no other, that they cannot leave the unimportant detail to others, but must carry with them the long years of professional training in the minutiae of engineering, instead of forgetting the unimportant matters and applying themselves to the broad principles of admistration.

"My feeling, therefore, is very strong that to the schools we must look for broader and bigger ideas in the education of those who are to become engineers, and to our technical societies for the inculcation of higher standards of practice and ethics, and to those societies, also, to instil into the engineer the better appreciation of his value to the community so that he may in turn command what he is justly entitled to—a better recompense for his services and a more important position in the administration of the affairs of the community."

Burning Up Canada

THE following comparison between the fire losses of Canadian and British cities shows at a glance how we are progressing backwards in this country. These figures were included in a paper read before the Insurance Institute of Toronto.

Hamilton	$1.88	London	$0.46
Vancouver	4.45	Glasgow	.76
Calgary	.95	Birmingham	.48
Regina	3.47	Manchester	.55
Halifax	6.66	Sheffield	.57
Toronto	2.45	Leeds	1.26
Brantford	1.98	Belfast	.09
Winnipeg	3.88	Bristol	.15
London, Ont.	1.05	Edinburgh	.21
Saskatoon	6.85	Dublin	.42

In the last ten years the average rate of premium for Canada has been $1.46 per 100 of insured value. In the United States it is $1.11, in Norway 45 cents, in Sweden 40, in Austria 30, England 23, Germany 22, France 21, Spain and Italy 19.

Thus it is seen that the average rate of premium for Canada is an extravagance of almost criminal nature. Rates on this continent are five times as high as they are in Europe.

Concrete, after the addition of water to the mix, should be handled rapidly and in as small masses as is practical. The amount of concrete that should be placed at once depends upon the construction and kind of concrete.

Engineering Topics in the Old Land

Contractual Interest—Misfeasance and Non-feasance: A Judgment in Favor of a London Borough Council—Concerning Expert Witnesses

Specially contributed by the London (Eng.) Correspondent of The Contract Record

THE report of the Committee of the Canadian Society of Civil Engineers on General Clauses for Specifications makes interesting reading, but the discussion on the clauses makes much more interesting reading. The clauses were, it seems, drawn up from the point of view of the engineer, and there were naturally many criticisms from the "contracting end" of the profession. That the contractor cannot claim any damages or reimbursements whatever for delays from any causes during the performance of the work is certainly unfair, and the inclusion of a clause by which a contractor can claim damages under certain conditions is certainly necessary. Plant and machinery are a form of capital, and interest on their value and some depreciation allowance should be paid while they stand idle. Again, as Mr. Duggan said, the best specifications are those which are fair to contractors, engineers and proprietors. When matters are in the hands of competent and trained men, this may reasonably be expected (with exceptions), but, as was pointed out, engineers have a multitude of assistants, some without experience, and some without any idea of the true intent of contracts. In these last few words one has the whole crux of the matter. "The true intent of contracts." Could this but be grasped, litigation, argument and dispute would be practically at an end, for the true intent of a contract is that it should be fair to all the parties concerned in it. Loose specifications, too, are as bad as tight ones, and perhaps above all is the personality of the engineer. The contractor must have faith in the engineer just as the engineer must have it in the contractor, and each must be prepared to interpret the specification clauses in a liberal spirit. Even then, the contractor will have to shine on the score of liberality, giving more than he receives, but he knows this and should allow for it in his estimate. The system of stock clauses is not to be commended, and their use should almost be restricted to definitions and matters of quite an elementary nature. The capable engineer will have no need for such clauses at all. Such clauses as the finality of the engineer's decision, the right of the engineer to vary the contract price, and others, should form no part of a contract. A clause which requires very careful watching is the following: "Any notice intended for the contractor shall be sufficiently authenticated if signed by the engineer or the purchaser." Let the contractor consider what it may mean to him if he is to take "notices" from the purchaser, especially as the term "purchaser" includes that person's "heirs, administrators, executors and assigns." The purchaser might assign his interests to a syndicate comprising 20 or more distinct individuals, each of which would be an "assign," with the right to give "notices" (whatever they may mean) to the contractor. He would truly be in an unenviable position. It is satisfactory to note that the report was referred back.

Misfeasance and Non-Feasance

It is sincerely to be hoped that the anomaly of misfeasance and non-feasance has not obtained the hold upon Canadian law that it has upon English law. A recent action against a London borough council has brought this once again before the public, and a bare recital of the facts cannot but interest Canadian engineers. Briefly, a lady was seriously injured while cycling owing to the defective condition of a gulley grating belonging to the council. The special jury before which the case first went awarded her a substantial sum by way of damages, but the question of law was reserved. It has now been decided that the action must fail, because the plaintiff has not proved misfeasance on the part of the defendants. As the law stands, it would appear that a local authority is under no obligation to repair and maintain its works. If, in the first place, the gulley grating had been placed an inch or two above the roadway, or anyway so fixed as to be a danger to the public, the verdict of the jury would have been upheld, for that would have been misfeasance on the part of the council. But when the same result arises from neglect to repair or maintain, the matter is one of non-feasance and the council is exempt from liability. In giving judgment for the council, the judge condemned the plaintiff to pay the costs of both trials and of the appeal, and it is comforting to know that the lady (a confectioner's manageress) is possibly not in a position to do this. An ounce of justice is worth a pound of law, owing possibly to its rarity. Everyone knows the story of the judge who asked the cabman to drive him to the Courts of Justice. "Never heard of 'em," replied the cabman. And on the judge giving him minute instructions the man added "Oh, the Law Courts. Why didn't you say so at first? Thought you said something about 'justice'!"

Expert Witnesses

While on the subject of the law, exception may be taken to a statement made in the Contract Record (February 3) by Mr. Harry Barker in his article "The Engineer out in the World." Says Mr. Barker: "Courts have long held more or less respect for expert witnesses." If he means literally "more or less," the writer is at one with him, and would lay special stress upon the "less." But in the ordinary use of the phrase, and as Mr. Barker uses it, the stress would have to be laid upon "more," which is a very different thing. A certain judge once said that there were three classes of liars: liars, damned liars and expert witnesses; and he was not far wrong. It is pitiful in the extreme to listen to a case in which expert witnesses are engaged on either side. The hard swearing is a revelation, and the most elementary fact is presented in diametrically opposed forms by men who, as regards at least the half of them, must know that they are guilty of wilful misrepresentation. Some few years ago the writer was engaged as witness in a large building dispute. One of the claims of the owner was in respect to a factory floor. This floor was of fireproof construction and was finished off with two inches of granite chippings and cement, floated to a fine surface. Such poor material was used that if a book was dropped upon the floor clouds of cement dust arose, while where the hands were seated the coke-breeze aggregate was exposed in large patches, after less than six months' wear. The expert engaged by the builder deposed that such a floor was not a finished floor, but only a foundation for a floor, and when it was pointed out that there was no mention in the specification of further works the builder pleaded that the owner was himself going to provide a surface covering of wood blocks or other material. Of course nothing was further from the owner's thoughts, the building being a new one to be completed by the builder ready for occupation under time and penalty clauses. But the experts gained the day, proving to the satisfaction of the judge—it was the late Lord Chief Justice, by-the-bye—that floors could not be finished off in cement and granite chippings. Here certainly the experts scored, but then with experts on both sides one set of professional men necessarily must score, and the result does not disprove the contention that expert witnesses are sadly mistrusted. It is no uncommon thing to find retired medical officers of health and municipal engineers forswearing all they have ever sworn during their public career, when they were acting for a council and not against one. Professional societies might do worse than call some of these gentlemen to account.

THE THINKER

Back of the beating hammer
By which the steel is wrought,
Back of the workshop's clamor,
The seeker may find the Thought—
The Thought that is ever master
Of iron and steam and steel,
That rises above disaster
And tramples it under heel.

The drudge may fret and tinker
Or labor with lusty blows,
But back of him stands the Thinker—
The clear-eyed man who knows;
For into each plow or sabre,
Each piece and part and whole,
Must go the brains of labor,
Which gives the work a soul.

Back of the motor's humming,
Back of the bell that sings,
Back of the hammer's drumming,
Back of the crane that swings,
There is the eye which scans them,
Watching through stress and strain,
There is the Mind which plans them—
Back of the brawn, the Brain.

Might of the roaring boiler,
Force of the engine's thrust,
Strength of the sweating toiler,
Greatly in these we trust;
But back of them stands the Schemer,
The Thinker who drives things through,
Back of the job—the Dreamer
Who's making the dream come true.
—Berton Braley.

There is a popular misconception abroad anent the spending of public money, and that section of the public which believes in what it is pleased to call rigid economy is not a small one. To this section, no public work is politic unless it shows a monetary return or dividend. Public convenience stands for nothing. The fallacy of this point of view may be proved in a score of ways. Street paving, for example, brings no tangible monetary return, and the rates on property would come in just the same if every side street in a town remained unpaved. Sewerage and sewage disposal, again, are cases in point, and building supervision and lighting are not without their application. The comfort and convenience of the community are the first points to be considered, and if means allow these should receive a full share of attention. In London, England, the Thames steamboat services were discontinued, because they didn't pay, and a splendid waterway now lies unused so far as passenger traffic is concerned, and all manner of shifts and expedients have to be resorted to, and all manner of vehicles engaged, to perform a journey from one point on the river-bank to another. Some hundreds of thousands of people are habitually incommoded simply because the steamboat services did not show a dividend, and London might just as well discontinue the repair and maintenance of Fleet Street or the Strand for a similar reason. The money expended on public utility works invariably comes back to the public, either directly or indirectly, and if more spirit were shown by municipalities the need for relief works would arise much less frequently. Mr. Norman Scorgie dealt with this matter in his presidential address to the Society of Engineers, in which he laid stress upon "the benefits derived by the community in the way of improved health and conditions of living by a judicious expenditure upon sanitation, water supply and kindred works."

IN the United States competition for contracts appears to be even keener than it is in Canada. The eagerness of the larger contractors for work was well illustrated at the letting of the Pennsylvania concrete viaduct over the Susquehanna River at Harrisburg, Pa. The estimated cost of this bridge exceeded the highest of thirty-eight bids by more than $100,000, and the lowest by nearly $500,000. There were fifty-four sets of plans out for bidding. The principal item of the contract was 56,000 cu. yds. of concrete, for which the remarkably low bid of $4.73 per cubic yard was received. The lowest ten bids on this item were below $6.00 per cubic yard, and all but one bid were below $10.00 per cubic yard.

A Michigan contractor using large quantities of cement is said to make a practice of erecting on the site of each contract a small shed about 6 ft. high, which is painted bright scarlet, after the manner of a powder magazine, with large signs painted on all four sides announcing it to be a "bag asylum." The conspicuous character of the shed, coupled with the impressive wording, is said to have worked wonders with his men, who now put all empty bags in the place of safe keeping. As dampness causes the cement to set and so renders the bags useless, the necessity for keeping them under cover is obvious.

The recent sale of Manitoba debentures at 98.85 is the best possible evidence of the soundness of the financial position of the province, and indisputable proof of the faith of financiers in the stability of its institutions.

Trade Expansion—What Germany Was Doing Before the War

Specially contributed by R. O. Wynne-Roberts, M.Inst.C.E., M.Can.Soc.C.E., F.R.San.Inst.[*]

WHEN contributing my quota to the interesting symposium on trade possibilities (see Contract Record, Feb. 17, 1915) I referred to the Diplomatic and Consular report issued by the British Foreign Office and Board of Trade on the trade of Germany in 1913. This report was presented to the Houses of Parliament in December last, and a copy has just been received. It covers one hundred and two pages, and is therefore too long to discuss in detail, but I propose referring to some of the salient points, to indicate what was being done in Germany in respect to commerce prior to the present war.

Sir Francis Oppenheimer, the writer of the report, states that Germans, in every stage of society, are prone to combinations." Every industry has its organization, and often its journal, and every branch of an industry is served so as to assure co-operation throughout. Combination is less effective in the British Empire; and in the Colonies it is not often heard of. At the present time the British Government is offering inducements for firms to combine to build up the dye industry which Germany had captured and built up on an enormous scale, but although the scheme has been modified more than once to meet the views of some firms, it has not yet been moulded into a shape acceptable to all concerned in that business. Combination is probably more successful in the United States, but the public opposition there is a factor which is apparently absent in Germany.

"Syndicates control production and sales, and—when the home market is satiated—help toward directing merchandise abroad. In an atmosphere of industrial depression, syndicates are seen at their greatest advantage—at least by their members." "There is no doubt," writes Sir Francis, "that after each successive boom the desire for syndication is strengthened . . . because every boom gives the members of the various industries a chance of extending their works and raising their capacity of output—which means an increased production, and, in consequence, greater competition during a slump. The cry for syndicates became louder as the depression progressed."

A syndicate guarantees the existence of smaller works, checks competition, secures steady prices in the home market, and provides export bounties for foreign orders. For the great concerns, however, syndication entails some financial sacrifice.

On the other hand, it is the expectation that syndicates will be formed during the slump that affords the explanation of reckless extensions during booms, for when the syndicate comes it is necessary for those joining, to show good reasons for the rate of participation which they desire so as to secure a comfortable future; consequently some firms are known to sell their products below cost price in order that they may be able to show a large business, for apparently those joining the syndicate pool their interest in proportion to the business done at the time they enter, which rating is revised from time to time. In times when trade is booming the syndicate can impose a fine on over-production, but as this is readily and gladly paid it constitutes a poor check. When it is understood that syndicates have accepted goods for sale amounting in the aggregate to considerably more than the members claimed to participate it will be seen how inadequate is the control. For example, if members can by various fantastic means contrive to show that they should participate to the extent of $1,000,000, but manage to foist on the syndicate goods to the value of $1,149,200, the power and usefulness of such a syndicate are nullified. Over-production, however, is afterwards counteracted by orders to reduce, and as all members have to bear their proportionate loss it spells hardship for those who have scrupulously observed the conditions of membership. Sir Francis Oppenheimer stated that "the foundation of every syndicate is accompanied by a colossal game of bluff—and the game is periodically repeated once the syndicate has come into existence."

Moreover, by the policy pursued by the syndicates, home trade is made "predominantly lucrative," and this is due in a great measure to the extension of the works themselves so as to be in a position to exploit impending booms, but competition is thereby increased by the high price of raw materials, and export business is forced.

The exports owing to this condition are increasing in raw materials and half-finished goods, while finishing industries in Germany have been complaining of the increasing prices of raw materials, because the prices of the finished articles could not be increased in the same proportion and still compete with the products of other countries. The result is that labour is affected. This is to be seen by the increased employment of women and juveniles. In four industries named the number of men employed increased by 13 per cent. between 1909 and 1912, but the number of female employees increased by 15.7 per cent., and juveniles by 16.3 per cent.

We have heard much of the willingness of German firms to accommodate customers by supplying what they want, and this has often been held up as an example for British firms to emulate; but there is a change, because of the increased use of machinery and the scramble for orders of standard patterns. Sir Francis states that "difficulty is beginning to be experienced in finding manufacturers willing to accept those stray orders for goods which differ from the ordinary patterns. Once the machine has been set for a while the experienced workmen of the older school cease to be available."

Concentration is another characteristic of German industries. The application of science to manufacture, the utilization of by-products to reduce the cost of production, the Emperor William Institute for the scientific exploration of coal, and another institute for the study of ores, etc., are typical of German methods. The concentration of industries under one roof and one management so as to be better able to compete with rival firms, and the absorption of other works—such as the Mannesman tube works absorbing the Schulz-Knaudt sheet iron works—so that eventually they will control a complete line of production from the raw material to the finished article, suggest a counterblast to syndication. Many concerns concentrate on shipping and transport facilities, and to aid them the

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[*] Consulting Engineer, Regina.

Government has acquired a controlling interest in certain shipping lines. Some firms concentrate on a financial combination so as to guarantee a steady sale of their vast output and the acquisition of shipping facilities, purchase of power, plant, etc., and to secure cheaper railway transport when bidding for foreign markets. Banks concentrate into smaller groups with their interests interlaced.

Weltwirtschaft—World Economy

It was the need for expanding the German export trade that dominated the public press, mind and movements, in 1913. Weltwirtschaft—world economy—which bears the same relation to the world as political economy does to the State and domestic economy does to the home—was advocated as Germany's mission abroad. As her colonies were insignificant customers, and would be so for a long time, the world was to be her trading empire, with certain countries such as Turkey, China and South America offering special advantages.

Weltwirtschaft appealed to the people and new publications, new institutes, etc., were started to make use of the idea. The Institut fur Seeverkehr und Weltwirtschaft (Institute for Marine Traffic and World Economy) was inaugurated at Kiel University on February 20, 1914, and another, the Weltwirtschaftliche Gesellschaft (Society of World Economy), was constituted at Berlin on February 22, 1914. The members set themselves the task of applying to export business those scientific methods which have made German industries so successful.

"Weltwirtschaft" (world economy) was the national slogan of Germany prior to the War, and will be again some day, doubtless. It had its influence in the moulding of public opinion, in the creation of organizations, and the direction of Imperial activities. It aspired to dominate railways, banks and shipping movements abroad. It was planning to revise commercial treaties which are about to expire. In short, the programme was to promote German export trade by German capital, German ships, German railways, and German banks.

The impending and, no doubt, successful bombardment and capture of Constantinople will frustrate Germany's plan to capture eastern trade by the Bagdad railway and its future extensions, which was one of the Kaiser's favorite schemes.

But the idea of the Weltwirtschaft is only a huge expansion of the suggestion made in my previous article—with one important difference. Germany's great programme had the active support of the German people; whereas in the British Empire, and perhaps even more so in Canada—apart from the Governments' work of collecting and publishing information as to the prospects in other countries—financiers, manufacturers and engineers are perforce dependent on their own initiative and capabilities to build up export business and secure foreign enterprises. This is the reason that I have in many quarters urged on the formation of an association of financiers, manufacturers, engineers, contractors, etc., to secure business at home and abroad. In addition to what has already been stated, there are German societies for representatives of trades, etc., to club together on these lines, and these societies have, at least, the moral support of the Government behind them.

Sandwiched in the report is an interesting statement that although capital for enterprises was becoming scarce and the boom had dissipated, yet when the Prussian issue of about $90,000,000 4 per cent. bonds were placed on the market in January, 1914, there was an apparent abundance of money, for the loan was over-subscribed for seventy times. The Moroccan and other troubles had caused the hoarding of money, and when those political troubles had been settled the money was unearthed again. There is reason to believe that the present European conflict was anticipated, because finance was stringent before August last, and the unsettled state of affairs induced the public to lock up a mass of wealth. When the troubles are over, this wealth will be released and investments for it will be sought.

In the matter of loans, if reference is made to my article on Municipal Loans in the 1914 Monetary Times Annual, it will be found that the French financiers often stipulated that a portion of the loans floated in France should be spent on French material, etc. Germany's paternal care of her foreign trade has brought about a similar condition. Commercial orders are obtained by advancing loans; for example, "Budapest's municipal loan brought Germany a rich crop of industrial orders."

The report, of which this is a cursory review, contains a large fund of information on the commercial activities of Germany, but that is left for others to deal with, as it is not pertinent to the topic under discussion.

" 'Speculative' is a word often applied to builders by many people who do not appreciate its full and serious meaning," comments The Building News (London, Eng.) in giving an interesting outline of the career of a speculative builder in the world's metropolis. Our contemporary continues: "The building of streets of new houses in the suburbs of London, or elsewhere, is a speculation indeed, or a lottery in which the prizes are few and far between, and the blanks very numerous. There are men who make money out of the trade, and, after selling the houses they have put up, somehow or other, retire and live happily ever after. But the struggle is severe, and only the fittest or the most fortunate survive the strain. The recent report of the bankruptcy of a London builder, on his application for a discharge, is an example of the difficulties and dangers that beset this business. Beginning in 1881, with a capital of some £300, and his trade as carpenter, he started on a career of speculative building, and in 1912 he failed, with unsecured liabilities not far from £200,000, and with assets, chiefly made up of equities in his properties, which he estimated as worth more than this big total, but which now only seemed likely to bring in about £2,700. Of course, his failure was mainly due to depreciation in value of his houses since 1907, though there was also loss in brickmaking and pressure by mortgages. The total cost of the properties he built came out at £1,909,845, which he managed to mortgage for £1,476,960. After all this money has passed through his hands, he is now left high and dry. But how many financiers, landowners, architects, surveyors, house agents, traders, and lawyers have made their protfis out of his enterprise meanwhile, and have had good cause to bless this long career of a broken 'speculative builder?' "

The adaptability of reinforced concrete for irregular sloping surfaces is well illustrated in an article in the "Engineer," London, describing the new Mappin Terraces at the Zoological Gardens. The structure consists of four artificial hills, and a number of sloping terraces which are very irregular, the hills being some 70 ft. high and covering an area of 39,000 sq. ft.

The employment of reinforced concrete solved all the constructional difficulties and enabled the work to be carried out at a cost far below that entailed by any other method of construction. Most of the surface of the hills was formed by a shell 3 ins. thick, and the lower terraces, where the heavier animals are quartered, have a thickness of from 5 to 7 ins. Incidentally the designer makes the claim that coarse, naturally graded, uncrushed ballast has invariably been found to give better results as regards both strength and density than the ¾-in. crushed ballast and sand mixture usually specified. A number of large water tanks were formed in the surface of the terraces, and made of concrete containing only the coarse aggregate. They were found to be absolutely watertight without the use of any waterproofing materials whatever.

The Restoration of Shattered Confidence

The U. S. Ideal as Conceived by John H. Fahey, President of the Chamber of Commerce of the United States

SHOCKED as almost never before in our history by the terrific impact of an unexpected war, the country's business was almost prostrated less than six months ago. The unsettling character of this disturbance you well know; and yet within this short period the recovery from it has been little short of marvellous. Able and patriotic business men, and resourceful organizations of business men, did their full share, working shoulder to shoulder with the responsible heads of the Government in repairing the broken down machinery and in restoring shattered confidence.

That this great historical happening will have far-reaching results cannot be denied. What the ultimate effects will be depends largely on us as a people, on the wisdom of our statesmen and the courage and leadership of our business men. Perhaps this catastrophe has brought us to a keener realization of our common interest than ever before. The farmer and the worker have come to see their dependence on the transportation agencies and the business men, and likewise there has developed an equally better understanding on our part of our relation to these other great interests.

It seems clear that we are going farther out into the world than ever before; that America and things American will be better known in lands where we have been almost strangers. In this evolution let us see to it that our America carries the impression we would like to have it convey, that it stands for liberty and justice and honest dealing. On no other basis can our influence be long sustained.

In the countries across the Atlantic now rent by strife, but a few months ago things of serious portent were developing. Violent social, racial and religious prejudices were aroused over projected reforms in nearly all of them. Even civil war threatened. But when the cataclysm came dissensions were forgotten over night. Rich and poor, high and low, came together in each nation in the common cause.

The example is sharply before us. Do we need any greater crisis than that through which we have passed so recently to make clear to all of us the necessity of real national co-operation and understanding? It is quite as patriotic, it is quite as much our duty, that in the blessedness of peace we should forget prejudices and partisanships and undertake to work together efficiently and persistently, supporting with all our energy that which makes for the greatness of the Republic and of its people.

As we go forward in this effort we will surely find that so far as business is concerned, unity of action and efficient organization will prove a great instrument for helpfulness and service. It is with this sense of service that we should support it and work for it—for better business and a grander Republic.

A Cheap Source of Power for the Contractor

So far as is known, comments The Engineering Record, the Diesel engine has never been tried, or even investigated, heretofore as a source of power for operating construction plant. The fuel economy and low labor cost of operation as compared with other types of power equipment have, however, gained for it marked recognition in marine and industrial service.

Considering total investment and operating cost, the Diesel engine, when used to operate a generator, is as cheap as any present source of electric power, not even barring cheap hydro-electric development. Industrial plants have availed themselves of it—why not the contractor? The latter, in addition, would make a considerable saving in freight due to fuel economy, especially where transportation facilities are poor.

The economies of running a contract with electrically-driven equipment are proved and varied. Wiring costs less in materials and labor than steam or air piping, and much less than the carrying of coal to small isolated boiler plants. Electric power, too, can be supplied to construction equipment with less loss in use than steam or air—53 per cent. less, it has been estimated, as compared with a hoisting engine run by air. Electric equipment, moreover, now costs little, if any, more than steam and air plant.

If then, electricity is a satisfactory form of power for the contractor, those undertaking good-sized jobs where 200 h.p. or more is used in scattered equipment should carefully study this means of making electric power, no matter where the contract may be.

For most contractors this is not a time for increasing overhead expense by the purchase of costly new equipment. However, the present depression is bound to end. Some firms have already gone far toward electrifying their field equipment. Why not take a further step and avail themselves of a source of electric power which may, except under unusual conditions, be had at a saving on any fair-sized contract in almost any locality?

Thos. Webb Nash, a veteran land surveyor and engineer of Kingston, Ont., died last week at the advanced age of 88. He assisted in the construction of the Grand Trunk Railway from Toronto to Montreal and became Chief Engineer of the Kingston and Pembroke Railway Company upon its organization.

New Type of Gravity Mechanical Filter for the Toronto Water-Works[*]

WHEN it became known that an additional 60-million Imperial gallons a day mechanical filtration plant was to be added to our present 32-million gallon slow sand unit, the John verMehr Engineering Company, Limited, asked the Department of Works to consider their new system of filtration.

This system depended upon an ingenious arrangement for automatically removing the surface sand of the filtering sand-body continuously, together with the dirt which is contained, washing it and returning it cleansed into the stream of raw water and coagulant coming on to the filter. As the system appeared at first sight to be not only ingenious, but practicable, and as there appeared to be a number of advantages over the standard types of gravity mechanical filters, it was agreed that if the company built a unit of half a million gallons capacity a day, it would be given a thirty-day trial by the Director of Laboratories of the Department of Health, and, if such test proved satisfactory, the company would be permitted to put in a tender for the sixty-million gallons installation. Accordingly, a site was selected adjoining the old West Toronto Pumping Station (on Ellis Avenue), which drew water from the Humber Bay, and the demonstration filter plant was built there in the spring of 1913. The site was chosen because raw water could be obtained from Humber Bay, which is always polluted with sewage, and frequently muddy, and also because water could be obtained from the city mains under pressure for washing back the filter whenever necessary.

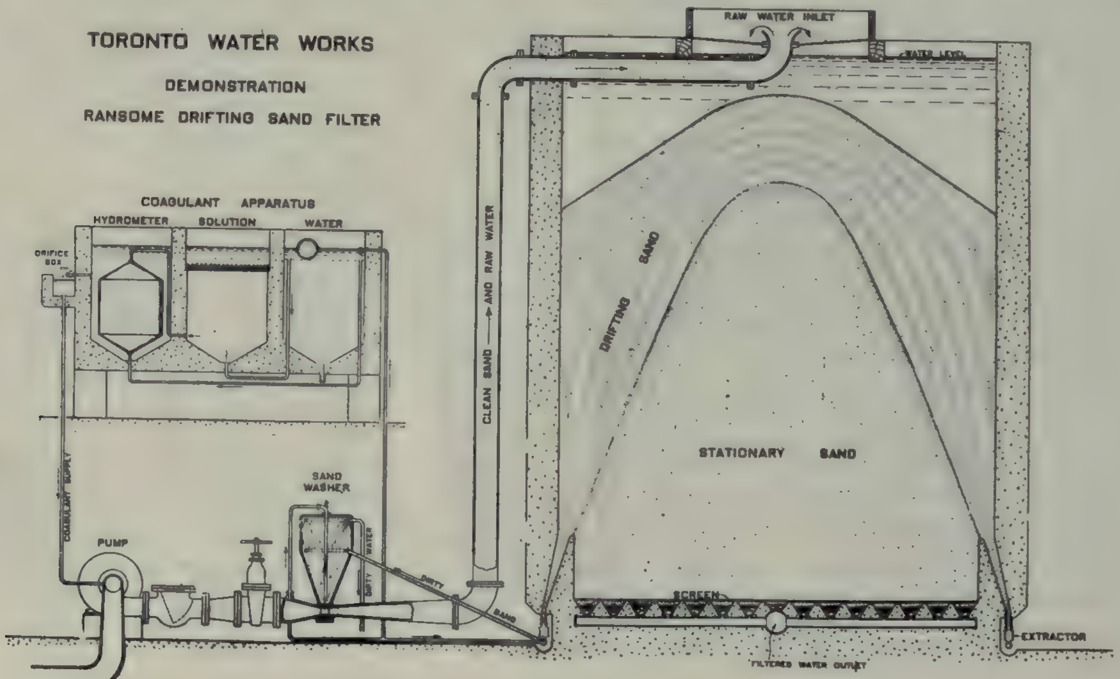

Fig. 1.

The plant was put into operation during the first week of May, 1913, and was turned over to the Department for the official test on May 21, 1913.

Description of Filter.—The arrangement of the demonstration plant is shown in Fig. 1. A centrifugal pump driven by an electric motor draws the water from Humber Bay in Lake Ontario, at a point about 700 feet from the shore, and about half a mile east of the mouth of the Humber River, and delivers it, together with a continuous supply of washed drifting sand from the sand washer, to the centre of the filter at its top.

The filter consists of a vertical cylinder of reinforced concrete deeper than usual in filter design, and is nearly filled with sand. The filtered water collecting system is at the bottom, divided into a number of small units consisting of a number of hoppers filled with graded gravel held in place by a brass screen fastened down to the concrete. At a distance of 2 ft. 6 in. above the underdrain system and all round the filter are a series of hopper-shaped ports down which the drifting sand passes. These ports converge downwards to extractor outlets, with glass inspection tubes so that the operation of the drifting sand can be watched. The extractors are controlled by cocks which can be adjusted to suit the character of the water being filtered.

The drifting sand from the inspection outlets is collected by a ring main system, along which is a current of wash water which conveys the sand to the sand washer or sand separator. The sand washer consists of a flat-sided, hopper-like vessel with glass windows at the flat sides through which the action can be observed. The sand washer is attached to the filter supply pipe immediately over a constriction in it something like the form of a Venturi meter tube. An opening in the bottom of the sand washer lets through the clean sand into the water passing, which conveys it to the filter and maintains the conical heap of sand in it. By the well-known hydraulic principle the pressure in the pipe at the constriction is very much less than on the filter. This difference is sufficient to draw the loose or drifting sand charged with dirt out of the filter into and through the sand washer and into the supply pipe, and so maintains the continuous motion of the sand while the filter is in operation. The sand, which by this time has become freed but not separated from the dirt, is led into the sand washer at about mid-height. The weight of the sand carries it to the bottom of the washer and the dirty water escapes at the top. Near the bottom of the washer is a jet of water which carries the sand downwards into the supply pipe, displacing the dirty water upwards in so doing. The water used for washing the drifting sand is unfiltered. The plan area of this filter is 143 square feet, or 0.0033 of an acre. The estimated surface of the stationary cone is 306 square feet, or more than twice the plan area. The average depth of the sand in the filter is about 13 feet, of which about 54 per cent. is drifting. The minimum thickness of drifting sand is about 2 ft. 6 in. and the maximum 10 ft. The minimum thickness of the stationary sand is 2 ft. 2 in. and the maximum 13 ft.

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[*] Report of an Official Test of a Ransome Drifting Sand Filter made for the City of Toronto by Geo. G. Nasmith, Ph.D., Director of Laboratories, and Fred. Adams, M.B., D.P.H., First Assistant to the Director of Laboratories—both of the Department of Public Health, Toronto, Canada.

The sand used was a local sand containing a large proportion of limestone. It was prepared principally by screening out the coarser materials and washing away the finer. The physical analysis of this sand shows its effective size to be .4 millimetres, and its uniform coefficient 2.7. It was passed through a sieve of 8 meshes per lineal inch. In the drifting sand the coarser particles tend to collect in the planes of maximum travel and the finer materials to drop through the coarser, thereby offering the coarser materials to the water first and the finer materials later.

Coagulating Plant.—A novel feature of the coagulating plant for the supplying of a solution of aluminum sulphate to the raw water is the employment of a large float or hydrometer-like arrangement for maintaining a solution of constant strength of about 1½ per cent., which is fed through an orifice under a constant head, the orifice being changeable. The arrangement is shown diagrammatically in the Section in Fig. 1, and consists principally of rectangular reinforced concrete tanks in series, coated with solid paraffin.

The first tank contains water supplied from the pumping main and maintained at a constant level by a ballcock. The water from this tank may pass either direct to the bottom of the solution tank or through the needle valve at the bottom of the hydrometer tank.

Solid crystals of aluminum hydrate are fed into the upper compartment of the solution tank in sufficient quantity to maintain the solution at any convenient amount in excess of 1½ per cent. The solution passes from this tank into the hydrometer tank through a needle valve at the top of the hydrometer. Thus the hydrometer tank is supplied either with solution at the top or water at the bottom, depending whether the hydrometer is up or down. The hydrometer, which consists of an oak barrel with conical ends of concrete, and provided with brass adjustable needle valve points, is weighted so as to just float in a solution containing 1½ per cent. of aluminum sulphate. The mixing of the two liquids takes place quite readily, owing to variations in density. The heavier solution coming in at the top commences to travel downwards, producing circulation; conversely, the lighter coming in to the bottom commences to travel upwards, again producing circulation, with the result that stratification at the orifice cannot be detected. The solution, before passing to the pump suction pipe, was further diluted about 200 per cent., so that when entering the raw water the solution was of about one-half per cent.

Alkalinity of Raw Water.—The alkalinity, as $CaCo_3$ of Great Lakes water at Toronto, is about 100 parts per million, which is capable of breaking up several times the quantity of alum that would ever require to be used.

Operations before Official Test.—The building of the plant was watched from beginning to end, so that no detail of construction was left unknown. Every subsequent change in operation or construction was also observed. The filter was run off and on from May 7th to May 20th, so that the plant was watched from every possible angle.

Duration of the Official Test.—The official test commenced May 21, 1913, and ended June 27, 1913, constituting a continuous test of thirty-six days. On June 13th the filter was closed down for five hours because the West Toronto Pumping Station was being used as a "booster" station for raising the city water pressure in the western part of the city. This was a matter in no way connected with the demonstration filter, but the arrangement of pipes, etc., made it impossible, during this five hours, to get water for the filter through the intake pipe in Humber Bay.

On June 15th the screen in the bottom of the filter broke and the sand had to be taken out of the filter, the screen repaired and the sand replaced. The filter was consequently shut down on this date. On June 19th the filter was shut down because the Hydro-Electric power was off. With these exceptions, the operation of the filter was continuous during the period of the official test both night and day.

Bacteriological Examination.—As a rule, two raw water samples and two filtered water samples were taken daily and these samples plated about one hour after taken. Counts were made on standard agar at 37 deg. C. for twenty-four hours. Red Colony counts were made on neutral-red bile-salt, lactose agar, at 37 deg. C. for twenty-four hours. B. Coli estimations were made on standard lactose bile grown at 37 deg. C. for 48 hours in the following quantities:— 50 c.c., 10 c.c., 1 c.c., 1/10 c.c., 1/100 c.c. Counts on gelatin for three days at 20 deg. C. were also made, but were discarded for this reason:—The filter was washed back with water from the city mains. In the city mains and in the reservoir, a bacillus multiplies at times which gives numerous yellow colonies on acid gelatin. Apparently this bacillus multiplied in the filter. This yellow organism grows on acid gelatin, but does not grow on neutral gelatin, such as that used as a routine by Dr. Houston, of London, nor does it grow on Agar in the warm incubator, and it is of no sanitary significance. The gelatin counts were consequently disregarded.

Chlorination Test.—On June 13, 14, 16 and 17 chlorine was added with the alum to the raw water to determine whether such a procedure would be suitable with this type of filter.

Bacillus Prodigiosus Test.—Following the completion of the official test on June 26th, a culture of bacillus prodigiosus was added to the water coming on to the filter in such quantities that the number of prodigiosus colonies per c.c. in the unfiltered water varied between 204 and 600. No prodigiosus colonies appeared on the filtered water plates.

Turbidity Test.—The Humber Bay water pumped on to the filter during the official test varied naturally in turbidity from 3 to 45. The filter effluent was throughout perfectly clear. Following the expiration of the official test, clay in a fine state of division was added daily for three days from 7 a.m. to 5 p.m. to the water coming on the filter. The addition of clay to the raw water was not uniform, so that the turbidity of the water coming on the filter varied from 375 to 650. The filter effluent was throughout this turbidity test perfectly clear. Throughout this test 1½ grains of alum per Imperial gallon were used and the filter was not washed back at any time.

Wash Water.—With this type of filter the wash-water is of two kinds.

The wash water which constantly carries the drifting sand out of the extractors to the sand washer amounted in this test to two per cent. of the total water filtered. This is raw water.

The wash water used to wash back the filter (about every eight days) amounted to somewhat under one per cent. of the total water filtered. This is filtered water.

The total wash water (both kinds) amounted to slightly less than three per cent. of the total water filtered.

Loss of Head and Washing Back.—The loss of head in the filter, immediately after washing back, when filtering at a rate of 500,000 Imperial gallons a day, was about 7 feet. Over a period of eight days' operation the loss of head commonly increased to 14 feet. It was found advisable to wash back the filter only about every eight days.

(d) Average Bacteriological Results Over Whole Test

Average Raw Water Count per c.c. on Standard Agar at 37 deg. C.	1365
Average Filtered Water Count per c.c. on Standard Agar at 37 deg. C.	13
Efficiency as per do. do.	99.0%
Average Raw Water Red Colony Count per c.c. on Neutral-Red Bile-Salt Lactose Agar at 37 deg. C.	106
Average Filtered Water Red Colony Count per c.c. on Neutral-Red Bile-Salt Lactose Agar at 37 deg. C.	0.7
Efficiency as per do. do.	99.3%

SUMMARY OF RESULTS

(a) When using ¾ grain of Alum per Imperial gallon

		Total Count		Average Per c.c.
Bacterial Count on 21 tests on Standard Agar at 37 deg. C.	Raw Water	17,283		823
	Filtered Water	196		9
	Efficiency		98.9%	
Red Colony Count on 9 tests on Neutral-Red Bile-Salt Lactose Agar at 37 deg. C.	Raw Water	1,069		119
	Filtered Water	1		0.1
	Efficiency		99.9%	

B. Coli in Lactose Bile

		Total Count		Average Per 50 c.c.
Number of B. Coli in 50 c.c. water. (21 samples)	Raw Water	18,150		864
	Filtered Water	139		7
	Efficiency		99.8%	

(b) When using 1 grain of Alum per Imperial gallon

		Total Count		Average Per c.c.
Bacterial Count on 13 tests on Standard Agar at 37 deg. C.	Raw Water	57,390		4,414
	Filtered Water	427		33
	Efficiency		99.3%	
Red Colony Count on 13 tests on Neutral-Red Bile-Salt Lactose Agar at 37 deg. C.	Raw Water	3,289		253
	Filtered Water	34		3
	Efficiency		99.0%	

B. Coli in Lactose Bile

		Total Count		Average Per 50 c.c.
Number of B. Coli in 50 c.c. water (13 samples)	Raw Water	28,550		2,196
	Filtered Water	710		55
	Efficiency		97.5%	

(c) When using 1½ grains of Alum per Imperial gallon

		Total Count		Average Per c.c.
Bacterial Count on 32 tests on Standard Agar at 37 deg. C.	Raw Water	15,452		483
	Filtered Water	261		8
	Efficiency		98.3%	
Red Colony Count on 32 tests on Neutral-Red Bile-Salt Lactose Agar at 37 deg. C.	Raw Water	1,351		42
	Filtered Water	3		0.1
	Efficiency		99.8%	

B. Coli in Lactose Bile

		Total Count		Average Per 50 c.c.
Number of B. Coli in 50 c.c. water (32 samples)	Raw Water	27,250		852
	Filtered Water	51		2
	Efficiency		99.8%	

(f) Average B. Coli Results in Lactose Bile Over Whole Test

Average number of B. Coli in 50 c.c.	in Raw Water	1120
	in Filtered Water	14
	Efficiency	98.7%

(g) Average B. Coli Results in Lactose Bile Over Whole Test with Chlorine Figures Thrown Out

Average number of B. Coli in 50 c.c.	in Raw Water	965
	in Filtered Water	15
	Efficiency	98.3%

(h) Classified Bacteriological Results Depending on Condition of Raw Water

(1) When Raw Water contained less than 50 bacteria per cubic centimetre.

Average of 28 samples in Neutral-Red Bile-Salt Lactose Agar at 37 deg. C.	Raw Water	28
	Filtered Water	0.07
(Red Colony Count)	Efficiency	99.7%

(2) When Raw Water contained from 50 to 500 bacteria per cubic centimetre.

Average of 36 samples on Standard Agar at 37 deg. C.	Raw Water	262
(Red Colony Count)	Filtered Water	7
	Efficiency	97.4%
Average of 24 samples on Neutral-Red Bile-Salt Agar at 37 deg. C.	Raw Water	140
(Red Colony Count)	Filtered Water	0.2
	Efficiency	99.8%

(3) When Raw Water contained from 500 to 2000 bacteria per cubic centimetre.

Average of 24 samples on Standard Agar at 37 deg. C.	Raw Water	1037
	Filtered Water	13
	Efficiency	98.8%
Average of 2 samples on Neutral-Red Bile-Salt Agar at 37 deg. C.	Raw Water	785
	Filtered Water	15.5
(Red Colony Count)	Efficiency	98%

(4) When Raw Water contained over 2,000 bacteria per cubic centimetre.

Average of 6 samples on Standard Agar at 37 deg. C.	Raw Water	9300
	Filtered Water	54.7
	Efficiency	99.4%

(e) Average Bacteriological Results over whole test with all "Chlorine" figures thrown out

Average Raw Water Count per c.c. on Standard Agar at 37 deg. C.	1420
Average Filtered Water Count per c.c. on Standard Agar at 37 deg. C.	14.8
Efficiency as per do. do.	99.0%
Average Raw Water Red Colony Count per c.c. on Neutral-Red Bile-Salt Lactose Agar at 37 deg. C.	100
Average Filtered Water Red Colony Count per c.c. on Neutral-Red Bile-Salt Lactose Agar at 37 deg. C.	.79
Efficiency as per do. do.	99.2%

Experience shows that the successful operation of chutes for the deposition of concrete by gravity can be assured by adopting an angle of about 45 degrees. The best type of chute is one of open trough section from 8 in. to 9 in. wide, closed sections being used only at bends and hopper outlets. An open trough is less liable than a closed chute to clogging, and any obstruction can be readily observed. The first portion of the chute, termed the "boom," rotating about and supplied from the concreting tower, should not exceed about 60 ft. in length, and the second portion, known as the "free end," may be of any length up to 50 ft., so as to facilitate the placing of concrete wherever it may be required within the area commanded by the distribution plant.

A French firm is said to be producing cement from the scum in pans used for beet sugar manufacture. The scum consists chiefly of calcium carbonate and water. Out of 70,000 tons of beet 4,000 tons of calcium carbonate is obtained. The scum is pumped into large tanks, where it is allowed to dry partially; finely divided clay is then mixed with it; the mixture is thoroughly amalgamated with beaters for an hour and burned in a rotary kiln. The clinker is then removed and ground in the usual way.

While lime mortar can be made strong enough for use in any ordinary building, and may be cheaper than cement mortar, it suffers from the disadvantage that it is readily compressed under load and requires some time to consolidate. Cement mortar, on the other hand, reaches its final form and consistency in a few hours, and no additional load has any effect on it. The consequent saving in time and certainty of measurements are special recommendations in favor of Portland cement masonry and concrete.

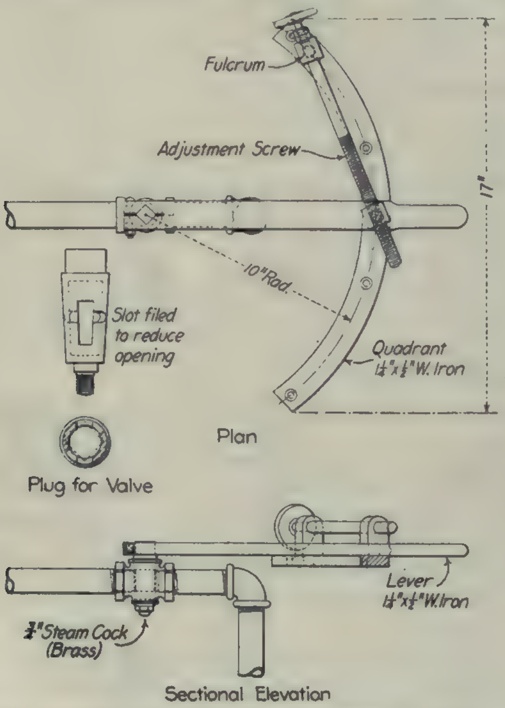
The tendency of the average contractor is to mix concrete too wet, the cement being washed to the lowest point of the forms, and the rest of the concrete suffers in consequence. Mixed too wet, concrete never attains its full strength. The mixture must not be so thin that it will seep through the joints in the forms.

Hints on the Control of Hypochlorite

Hydraulic Mixers, Specially Graduated Scaled Boards and Constant Head Barrels Instead of Orifice Boxes Are Features of the Plant at Denver

HYDRAULIC mixers of the type used in cyanide plants are employed to dissolve and mix bleach in the four installations which sterilize the water supplied by the Denver Union Water Company. Other novel details of these plants include the graduation of the scales on the solution tanks in pounds of solution and the control of the flow from the constant head box by special long-lever controlled plug cocks, stated W. W. DeBerard in a paper presented before the Illinois Section of the American Waterworks Association, and reproduced in The Engineering Record.

In the arrangement at Willard, where there is a 10,000,000-gal., rapid filter plant, two horizontal solution tanks, 12 ft. long, set 5 ft. on centres, are made out of 48-in. wood-stave pipe. Above one end of these tanks is a mixing tank consisting of a 50-gal. barrel with the necessary inlets, outet pipes connecting the mixing barrel with the solution tanks, water supply and drain. To agitate the chemical with the water in the mixer barrel, a 1-in. pipe entering at the bottom is reduced to a ½-in. nozzle which extends up into a 2-in. four-way cross. The side outlets of the cross are open. From the top outlet a 2-in. pipe extends above the top of the barrel and terminates in a tee into which are screwed nipples and turned-down elbows. The discharge is thus given a downward motion. A branch carries part of the supply through the side of the barrel about 2 ins. above the bottom. A 45-deg. elbow with a ¼-in. nozzle on the inner end of this pipe gives the solution a whirling motion which throws all of the sediment to the centre.

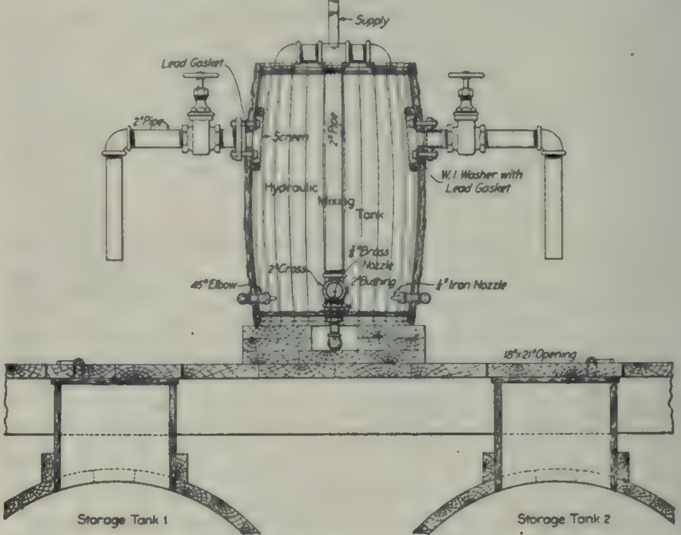


Scales on solution tanks are graduated to pounds of solution.

Operation

In operation enough of the dry chemical is weighed out to make up a 1 per cent. solution and is dumped out into the barrel, which is full of clear water. Filtered water under 75 lb. head is then turned on. The jet action of the water entering the tee at the bottom of the barrel pulls water and undissolved chemical into the central pipe, or hydraulic elevator, as it is called, and discharges it at the top. The swirling motion of the water entering at the side of the barrel rolls the undissolved chemical constantly toward the centre, where it is drawn into the elevator by the injective action of the water entering through a ½-in. nozzle pipe. Screens prevent lumps from passing to the storage tanks through the 2-in. overflows.

In half an hour practically all of the hypochlorite is discharged from the hydraulic mixer, and the storage tank will be one-half to two-thirds full. The remainder of the clear water to make up the solution to proper strength is brought into the bottom of the tanks midway between the bulkhead ends. Two-foot lengths of pipe terminating in ½-in. nozzles are screwed into a tee on the inlet pipe to give an additional mixing by the swirling motion produced. Numerous tests at the surface, centre and bottom of the storage tank after standing eight hours indicate a variation of less than 0.43 per cent.



Details of hydraulic mixing tank at Denver Hypochlorite Plant.

Scales Read in Pounds

Solutions of 1 per cent. strength are invariably used. A glass guage on the end of the tank is graduated to read directly in pounds of chemical. Readings of the guage are taken at one-hour intervals and adjustment is made if the necessary quantity is not feeding. By having the scales read in pounds a very simple calculation gives results, in grains per gallon, sufficiently accurate for all practical purposes. The expression pounds used between readings divided by the product of the minutes between readings and the rate of flow of the treated water expressed in million gallons per day gives, within 1 per cent. of the correct figure, the grains per gallon applied. Following the recent practice of expressing results in pounds per million gallons, the weir scales have been calculated to read in gallons per hour, so that one division gives results at once, the solution tank being read every hour.

Graduation of the scale is accomplished by actually weighing into it 200 lbs. of water from a small barrel resting on a scale. Points are marked on the scale board after each addition. Graduations between these intervals are interpolated down to 10 lbs. of water, which, with the 1 per cent. solutions used, means 0.1 lb. of chemical. A 4 x 4-in. pine stick is grooved to admit the ½-in. glass guage flush with the outside. The pound marks, about ½-in. apart in the centre of the tank, extend across the face of the 4 x 4-in. stick, while the 1-10 lb. marks are on a graduated strip at the back of the glass, an arrangement permitting easy reading.

To obviate the etching of the glass tube by the hypochlorite, clear water is run into the tube as soon as the storage tank is filled or the guage cock may be closed during the filling operation so as to exclude the hypochlorite solution at all times. The difference in the reading due to the difference in the specific gravities of the water and the solution is too small to correct.

Constant Head Control

Instead of the usual orifice box a simple arrangement used by the company for some time in the feeding of coagulent solution at the Willard plant has been used with slight modifications for the hypochlorite of lime feed. The former coagulent rig consisted of a 30-in. vitrified sewer pipe set bell end down and filled in with about 10 ins. of concrete to make a bottom.

A constant head supply to this tank was furnished through an ordinary brass hopper ball cock. The outlet was through a plug cock with a lever handle extended by a wire pointer over a graduated board. The graduations were arbitrary, as the cock was eaten out in time and gave increased discharges for the same setting. This was of little consequence so long as the cock did not leak, for reliance was placed entirely on data obtained by reading the gage on the solution tank for applying the correct amount of coagulent.

In the hypochlorite-of-lime plants the vitrified pipe was replaced by whiskey barrels. Ordinary ball cocks with paraffin or blocks of wood dipped in asphalt are used to keep a constant head and ¾-in. steam cocks with extended lever handles control the discharge. A fine adjustment screw with the fulcrum and nut set in tapered holes in a fixed quadrant and the lever respectively allow the operator to remove the screw, flush the valve and replace the lever at exactly the former position. The plug in the cock is filed away for ⅜-in. to give a fine stream.

The design and construction of these various devices were carried out under the direction of D. G. Thomas, chief engineer of the Denver Union Water Company.

Concrete aggregates should be protected from intense heat in summer, and from freezing weather in winter. If the materials have been subjected to the heat of the sun, they are liable to cause trouble in the mixer by tending to cake the cement. When there are indications that the aggregates have been frozen means should always be taken to thaw them out, either by forming a hollow in the material and building a fire therein, or by putting the material in a sheet metal pan under which a fire is lighted. Usually these simple methods are sufficient, although more elaborate ones might be employed.

The Architecture of Belgian Towns

In old London, at the University College, an interesting course of lectures on the above subject is being given by M. Victor Horta, Director of the Royal Academy of Fine Arts at Brussels. In his opening address M. Horta devoted the greater part of his remarks to a consideration of the general influences affecting the growth of both town and architecture in his native country. As far as building materials are concerned, the southern provinces of the country are so rich in stones of many colors and beautiful marbles that big nations might well envy them. In the north, in the flat country, these materials are rare, but there is no lack of brick earth. Turning to the subject of the lay-out of the towns, the lecturer considered three types. First, those with streets radiating from one centre, such as Malines and Brussels, though in the latter the modern tendency to imitate Paris has rather obscured the original plan. Secondly, he took those towns which have streets running parallel to each other and, usually, a big waterway, such as Antwerp and Maestricht. In the third type he embodied towns laid out around various important points or roads. Brussels, Antwerp, and Ghent, which have expanded very much, have at times been sadly reconstructed. Ghent particularly needed knowing well before one realized its never-ending charms. Ypres, on the other hand, had been content to remain the beautiful old town it had been. The lecturer illustrated by means of several slides of houses in Ypres, Ghent, Tournai, Liege, and Bruges how the Walloons preferred the gable to the cornice. In fact some architects held that the blue limestone was not suitable to classical profile. Proceeding to describe the characteristic features in the evolution of architectural schools during the last seventy-five years, he remarked that in the early part of the nineteenth century there appeared to be a revolution in their architecture. Three different schools started, the Classic revival, the Gothic revival, and the "Neo-almost-everything." He illustrated each school and particularly drew attention to the fine classical front of the Palais des Beaux-Arts at Brussels. M. Horta concluded with a prediction that destroyed Belgium would be fittingly rebuilt, and that the necessary funds could be obtained in some way or other from the aggressor.

The most recent Italian earthquake, with its record of 35,000 people killed and 45,000 injured, carries its lesson so far as construction is concerned. Newspaper specials from Rome agree that the great mortality is attributable to the method of dry construction employed in the affected region, the stones being piled upon each other without mortar. The only buildings which escaped total destruction were the modern houses.

Alex. Duncan, the expert road builder of Seaside, Ore., has about completed plans for a road machine that will revolutionize road work. The machine in question, so Duncan states, will plow up the road, grade and grub the right of way; all stumps will be carried on an endless chain through a hopper that will grind the wood into a pulp, press this into blocks for wood paving; and the extract of juice from the wood will be manufactured into denatured alcohol, which will propel the machine along the highway while at work!

The Larger Problems of Town Planning

Abstract of an Interesting Paper Presented by Thos. H. Mawson at a Recent Meeting of the Town Planning Institute in London

IN undertaking the remodelling or improvement of an existing city, and in the creation of a new one, we have two problems which, in one way at least, are fundamentally different. In the first case we have before us not only so many streets, so many buildings, and so many spaces with which to deal, but, what is far more important, the individual communal and civic spirit which has made the city what it is socially, morally, educationally and commercially.

In the new city, on the other hand, we are faced with the task of estimating, so far as we can, what form the city's individuality will take, and how far its course of development may be influenced for good, and to what extent the development is beyond our control, and must be met and allowed for in all our operations.

It will thus be seen that, whether the sphere of operations be an old city or a new one, the first essential of the city planner is a thorough study of the origin and growth of cities coupled with that knowledge of men and things and that reverence for the antique which always accompanies it, so that he may be able to read on the face of things as they exist not only the city's history, but the impress of the civic spirit and the individuality resulting therefrom.

The Strategic Factor

From the very earliest days—from the days, in fact, in which men first joined forces for defence against elemental forces—the paramount motive in city building has been strategic, and nothing is written so largely and so plain to see on the fabric of towns as this strategic element. At every point in their history it has had its influence, and nothing could be more mistaken than to suppose that it is not visible in the new towns which are growing at the present time in our own country, but more particularly in our colonies. The strategic factor is present to-day, for each city seeks a site which will give it strategic advantages in the field of commerce, just as the old city did for the field of battle. The scene has shifted, but it is the same stage and the same drama, shall we say, "localized."

The reason for this careful inquiry into the origin of the city we are to plan in particular, and of that of all cities in general, hardly needs elaboration or even explanation, for this is obviously the first step in the study in the growth of cities, and, unless our training in this subject is deep and thorough, we cannot rightly estimate the lines on which the city we are planning will develop in the future.

Having thus solved the first point in our search through the city's past, and having determined what factors contributed to its placing, we now have to determine how far those conditions still operate, and to what extent; and also what other factors have grown up in the city's life, and are likely to grow up in the future, which will modify or change the direction of these influences.

First of all, throughout our investigations we shall find the evolutionary principle at work, and the more we look into the matter the more we shall become convinced that nothing happens in the whole history of a city which has its influence on its growth or decay which does not partake of the nature of an influence working through evolutionary processes.

If the town planner is to realize the highest and the best that each opportunity affords he must cultivate the broad outlook, and must carry his survey far beyond the confines of the place itself. Wherever the town is placed the designer will always find it necessary to take into consideration many factors which take him far afield beyond the actual scope of his operations.

I think in the few words I have so far said I have clearly indicated the three great rock-bed principles on which all good work by the town planner must rest, and which apply with equal force to every problem he is called upon to solve.

While, however, it would be disastrous for the town planner to approach his task with preconceived ideas as to the direction his improvements should take, he will always find that the main part of his preliminary work in first viewing the sphere of his labors and making an itinerary to get the geographical factors fixed in his mind will revolve round these first principles.

I do not mean that the whole of the work of the planning of a town should fall upon the shoulders of one man. This is far too much to expect of one individual, and no man could possibly be omniscient enough to render such an experiment successful. While admitting many notable exceptions, I would even go further, and say that the bane of the town, village and suburb planning which has been done so far has been that it has been placed in the hands of men who have usually been chosen for the task because they have shown considerable ability in one side of the work—such as architecture or administration—and who have been expected to evolve out of their inner consciousness a scheme which shall fulfil the social, practical, or artistic requirements of which his special training has given him no expert knowledge.

How suicidal such a policy is! You will hardly be able to conceive any person differing from me when I assert that a town plan must be the result of the joint efforts of the surveyor, the architect, the sanitary engineer, and the landscape architect, the sociologist, and, in the case of an old town, the antiquarian, never forgetting, of course, the necessity for legal guidance at every stage of progress.

First will come the antiquarian, who will schedule all that through its connection with the history of the town or its intrinsic beauty must be preserved, and who will prepare archaeological records, aided by photographs and plans, of all that is old, but which is not important enough to be allowed to stand in the way of that which is modern and hygienic; then will come the surveyor, who will prepare those contour plans on which the subsequent operations will be based; and after him the sanitary and hygienic engineer, who will determine on the source of the water supply, the pressure at which it can be delivered, and consequently the maximum height up the hillside to which we may build, the position of his sewerage disposal scheme, and consequently the lowest points at which sewers can be connected to it by gravitation, and will also suggest to the sociologists sites which will prove suitable for the provision of the other public services, such as power stations, gas works, and the like. With these materials before him, the sociologist will decide the density of the population and the number of houses to the acre which can be allowed over different parts of the site, the educational and recreative facilities to be provided, the location of varying classes of property with a view to social problems and amenities, and the connection between the artisan and his work, and, within the limits specified by the engineer, the location of the factory area. Thus is the material produced for the work of the town planner, and it is his province to take all these results of the labors of his confreres in city building and weld them into one co-ordinate and self-contained whole, a whole which shall express efficiency and beauty from every point of view and from every standpoint, whether that of the architect, garden lover, or sociologist, without sacrificing for one moment any of the solid qualities demanded by the practical citizen. This he will do not by the supervision of meretricious ornament, but by balancing mass against open space, height against breadth, the open vista against the enclosed colonnade, level masses of subdued and restrained architectural facades against the telling note of the tower with its strongly marked vertical lines, nobly spreading trees against the open glade, bright colors reflected in still water, and so on, all in mass, and with the broad outlook, leaving to the architect and the horticulturist the filling in of details in a manner consonant with his vision of the city to be.

I do not mean you to infer that each of these specialists will take up the work in turn and do his own special task independently of the others. Their spheres will interlock at every point, and if the city planner adequately fills his office he will be in direct communication with them all during the whole process. His is a task calling for infinite patience and infinite tact, but above and beyond this his training must fit him to sympathize with the aims and the point of view of all the others. He must have a knowledge in the round of each art which is necessary to his work, not only that he may the better understand and appreciate the point of view of each specialist, and so, by intelligent sympathy encourage all, but in order also that he may adequately fulfil his special task, which consists in forming one concrete whole composed alike of the artistic and practical out of the mass of oftentimes conflicting material which the various workers will place in his hands. Nor would the group of specialists ever be the same for each fresh feature which would call for fresh expert advice.

Thus we have a brief synopsis of our task, which, though necessarily sketchy and imperfect, cannot fail to raise in the mind of any man who is possessed of sufficient spirit and imagination to fit him for a place in the profession, a great and lasting enthusiasm for the practice of city planning.

Let us take the main principles enunciated, and see what are a few of the more obvious lessons to be drawn from them. The principles are as follows:

The Fundamentals

That each part of the city plan and each separate feature should be designed with strict regard to its connection with every other part.

That all efforts of town improvements demand that broad outlook which, by co-operation with other arts and science, will embrace and correlate factors belonging to all sides of the subject—aesthetic, ethical, sociological, hygienic, commercial, and recreational.

That the principle of design-in-mass, with the accent concentrated and the mass subdued, should receive due recognition.

That only by the broad outlook which will comprehend the past and the present and, as far as is humanly possible, the future, and which will grasp and control all the factors which make for the evolutionary advance or decay of cities, can success be achieved.

From these ethical principles, which ought to be the dominating influences governing our conception of the art and science of town planning, let us now turn to the economic factors which in this materialistic age are not only to be observed, but which, in the vast majority of cases, are primarily operative to the exclusion of all other factors. Our schemes to-day have to be something more than academic proposals—we have, in short, to prove that what we plan will also pay, either in the shape of interest (in terms of money) on the capital expenditure, as in waterworks, gas, and electric and tram undertakings, or in terms of increased mental power, as from the provision of adequate educational facilities or physical efficiency such as we expect to reap from better housing and the provision of parks and playgrounds for the community directly affected.

We must never forget, therefore, that the practical man has always at the back of his mind an adequate return on his expenditure, and I say he has a perfect right to expect it. I would urge upon every town planner that the only reasonable position we can assume is that an adequate return on municipal expenditure can only be attained by the adoption of town planning methods, and this further fact that, when we have attained perfect efficiency, which is always economic, in any department of our enterprice, we have at least laid the foundation of true beauty, for utility itself is potentially beautiful. On the other hand, the creation of beauty, as in a public park, is only economic in proportion to the number of individuals whose needs it properly serves, and this depends upon accessibility.

The first essential of a town plan is that it be compact with its many activities, commercial and industrial, concentrated to secure every advantage of transit, especially of heavy inward and outward manufactures, and where it can take full advantage of cheap power, light and heat. Our plans should aim at reducing the wear and tear over main arteries by the reduction of heavy traffic by placing factories and power stations and warehouses in direct connection with railway system, river and sea ports.

Having first secured the most strategic and economic position for his works, it became, in consequence, possible, and as a natural corollary, to house his workpeople in the most perfect manner, and from this a reflex action is now taking place, and the additional profits derived from an economic position, invested in model housing, is, on its part, paying double interest in the shape of increased physical and mental efficiency.

The circulatory system of arteries and main roads should form the anatomy of our plan, and should, to my mind, be first solved diagrammatically, our first care being to secure a scientific and economic solution which will aim at directness and avoid steep gradients or tortuous roads, for every loss of momentum is a tax on the community.

A New and Simple Method for Securing Dustless Concrete Floors*

By P. M. Bruner†

PORTLAND cement concrete sidewalks, having a top coat richer in cement than the concrete of the body of the blocks, are giving such general satisfaction that this paving has displaced those of almost all other materials. Even for driveways and roadways, concrete is beginning to compete with other favored materials, and with good prospects of superseding all other materials where the traffic is not excessive. Under these circumstances it has been a puzzle to find out why the wearing surface or top coat on reinforced concrete floors inside of buildings has given such scant satisfaction. The same composition for top coating, giving satisfaction in the basement, often is worthless when applied to the reinforced concrete on the upper floors. In the last few years technical papers have been full of complaints and suggestions on this point. Under special and unusual conditions, good floors have occasionally been laid of reinforced concrete in the ordinary way. For this and other reasons most experiments seeking to overcome the trouble have also been successful at times, and yet more often have been failures, thus leaving the faultiness uncorrected and the cause hidden more completely by misdirection.

And here perhaps is the place to define faulty, or so-called "dusty" floors. All floors are dusty that wear at all, and in cities all floors are dusty whether they wear or do not wear; but in this latter case all of the dust comes from sources other than the floor itself. The dusty floor that confronts and concerns the concrete worker is one in which the fine sand or other aggregate ravels out or rolls out of its bedding under moderate rubbing, scratching, or rolling of wheels. This produces, incidentally, both the objectionable dust and grit.

Such continuous failures have naturally created a demand for correctives to be applied after the failure has occurred, or for hardeners to be added to the original composition to assist the cementing potency of the Portland cement sufficiently to avoid the failure. One corrective of a floor that is faulty is the subsequent painting with ordinary paint, or with paint that has more or less varnish in it. These paints serve in part as a wearing cover, and in part as an agglutinating agent between the grains of sand. They also prevent water from reaching the interior of the top coat thereafter which otherwise might penetrate and aid in the hardening process in the course of time. Another corrective of a floor that is denominated "dusty" has found advocates. In this process the floor is rubbed or ground with a piece of grindstone, fastened to a handle, and assisted by some loose sand scattered over the surface of the floor. This work is so performed that the soft cement between the grains of sand on the upper surface of the floor is rubbed out without disturbing the grains of sand in their bedding. When almost the whole of the upper halves of these grains of sand is exposed the rubbing is discontinued and the spaces around the grains of sand are filled with neat cement which is ground in with the same rubbing instrument. This process may form a strong filling around the grains of sand, as also a very thin covering over the top of the grains of sand. This is good as far as it goes, and will enable a job to pass inspection that would not pass before. It adds, however, no strength to the weakened cement immediately below the middle of the grains of sand. On this account the trouble may return after the floor has had some service. Instead of remedying the faults of a finished floor, efforts have also been made to increase the cementing potency by adding so-called hardeners to the Portland cements. The active ingredients of most of these hardeners are, chiefly, fine pulverized iron and sal-ammoniac which are supposed to make between the grains of sand the old and well known rust-joint, in conjunction with the Portland cement. The work done by us with these hardeners, under the instructions of their official specifications, and under the advice of their superintendents, has failed to justify the claims made for the hardeners. Tests made for us by the Robert W. Hunt Company, with and without hardeners, did not show any advantage for them. Under unusual conditions, as said before, good work has sometimes been done by the ordinary routine work, hence one may surmise that these hardeners have given satisfaction and have been credited with benefits due to other causes than their own inherent value.

According to my observations and experiments, I came to the conclusion that cement top coating on reinforced concrete remains weak and deficient in strength because of the excess of water that is required to make the mortar plastic enough to be properly spread and struck off with a straightedge. This excess of water has no chance of escape downward, and rises toward the surface, where it remains until the setting process of the cement has well advanced. When a certain portion of the water has become bound in this way, in the setting process, the mortar stiffens up and becomes ready for the usual process of finishing and smoothing. Sometimes the setting goes forward too rapidly, so that the finishing cannot be carried out without sprinkling some water over the top to enable the workmen to work out a smooth finish. It follows that the floor is finally finished only after a period of four hours to twelve hours after the completion was first made into a plastic mortar. Not only is the strength of such a floor injured by the excess of water bound and entangled in the pores of the mass, but also by the disturbance of the crystallization process.

The only feasible way to overcome the difficulties, then, seems to be that to withdraw the excess of water that was necessary for the spreading and the rodding of this plastic mass to the desired level or grade of the finished floor. To bring this about, therefore, I lay on the plastic floor surface, when brought to its proper level, a webbing of some kind, and place over this some dry material which quickly withdraws the excess of water by the capillary attraction of the dry materials. This may take up 20 per cent. to 30 per cent. of the water originally used in producing plasticity of the mortar. It will not take up more than this, however much dry material is applied, and the amount of water left in the mass corresponds quite well with the amount that a professional cement-tester considers necessary in making proper test pices.

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* Paper presented at the last Annual Convention of The American Concrete Institute.

† Of the P. M. Bruner Granitoid Company, St. Louis.

My surprise in my first experiment, in regard to the condition of the top coating after the cloth was lifted off with its load of damp material, was great. It had become so hard or stiff, in 20 minutes after the dry material had been placed over it, that one could walk over the surface without making even a heel mark. In fact, the coating was so dry and stiff that it required a powerful effort to float it with a wooden float to an even finish that could be smoothed off with a trowel. This effort, however, forced the grains of sand so much closer together that in this way some moisture was forced upward from within the more compressed mass, so that the floor could be properly smoothed off. The time between the spreading of the mortar and the smoothing of the floor need not be more than thirty minutes. Without the use of this drying process, we have, as said before, found that it would require the expiration of from four hours to twelve hours before the work could be successfully brought to this stage.

What I claim for this process is: first, a harder and denser top coat; second, a wearing coat that is equal to the best work on sidewalks; and third, the elimination of overtime work by an extra expenditure for labor of only 1/10 cent to 1/5 cent per square foot in laying a floor, and this extra expense is more than offset by the usual cost of overtime work. I do not claim to improve the cement, but I simply get out of it all the strength there is in it. If any hardener can be found that will increase the wear-resisting quality of Portland cement concrete, this process of mine will still be a profitable one, inasmuch as it increases the density of the resulting cement topping, and the work proceeds without delay and without the need of overtime work. The process is even more desirable where the wearing coat is placed on the reinforced concrete soon after this has been poured. In this case there is still less chance to get rid of the excess of water downward, for the foundation itself in this case is saturated clear through the mass with the water used in making the concrete itself liquid.

It is perhaps also well to point out that the top coat placed over reinforced concrete should not be made too heavy. There is considerable difference in the expansion and the contraction of the two materials under standard specifications. A medium thickness of top coat will therefore more readily adjust itself to the reinforced concrete beneath. A heavy top coat, on the other hand, may assert itself sufficiently to bring about a powerful shearing strain between the two, so that they will separate at the expense of the weaker mass. Specifications should not call for more than a ½-in. thickness, nor allow a maximum of more than 1 in. A top coat of ½ in. thickness on sidewalks, subject to the heaviest traffic, will last more than twenty-five years. The top coat should not be made to correct irregularities of the surface on which it is placed. Those who lay the so-called sanitary or magnesian cement floors will not undertake to lay a greater thickness than ⅜ in. to ½ in. thickness because this material expands still more than any Portland cement concrete. Because Portland cement topping demonstrates this fact less clearly, it is generally applied in thicknesses up to 1½ in. to 2 in. The reinforced concrete contractor can, if he will, obtain a levelness that will require no extravagant thickness of topping. He can also construct this floor so that there will be no laitance on it. This laitance is a soft, chalk-like mass that has not sufficient strength to hold the topping, or even to hold to the concrete beneath, itself.

Title Deeds in Stone

AMONG the inscribed monuments which have been rescued from the grave mounds of Babylonia is a curious series of stones covered with inscriptions in very archaic writing, and sculptured with mystic emblems, which were regarded generally by scholars as representing the signs of the Zodiac. These stones were just rudely rubbed down and smoothed sufficiently to receive the sculptures and inscriptions, which were among the earliest cuneiform inscriptions brought to Europe. The stones are called by the Babylonian name of Kudurri, a word interpreted as "Land Mark," and are akin to the Roman termini, having been set up upon certain plots of land to indicate the legitimate right of the owners to the property. The stones, with rare exceptions, belong to one period, that of the rule or dynasty of the Kassite kings in Babylonia, a period lasting from about 1800 B. C. to the Assyrian conquest of Babylonia in 747 B.C. The British Museum possesses about twenty-five of them.

Kudurri are most interesting monuments, in that they are not distinctly Babylonian in origin, their use having been brought into the country by the Kassites, a people who came from the mountain regions to the north-east of Chaldea. In the majority of instances they are rude stones and boulders, and, therefore, no doubt, originated in the custom of setting up a "stone of witness" at the corners of private property, on which were first inscribed or cut the totems or symbols of the tribal god, and later on inscriptions setting forth the right by which the holders held the property.

The nature of these important documents may be best shown by a quotation from one of the earliest examples—a grant of land to the libation priest of the god Bel. Here we read:—"Kadashman-Enliv, the king, has presented (this land), and he has set up a boundary stone. Whosoever shall alter this boundary stone, or reverse the ownership of this land, may Nenip, the lord of the boundary stone, alter his boundary shrine and tear up his foundation."

Many of the inscriptions are particularly interesting from a legal point of view, for they record with very full details the legal disputes which arose from time to time regarding the properties. In regard to the legal disputes as to property, the Babylonian of that period seems to have been as fond of litigation as the modern Hindu, and the pleas of one side inscribed on the monuments reveal many curious details of Babylonian law.

The use of building paper in lining forms needs constant attention in order to secure satisfactory results. The paper is easily torn in placing reinforcement and in shifting the forms, requiring much patching. It is also somewhat difficult to keep the paper absolutely smooth so that the final surface does not show any wrinkles.

Papers Presented at the Second International Good Roads Congress Held Recently in Toronto

Concrete Roads and Streets*

By Frank Chappell, Town Engineer of Oshawa, Ont.

A paving fact and an important factor in road construction is that no pavement is permanent. The term "permanent pavement" should not be taken as literally true, but only relatively so, for it is common knowledge that all pavements commence to deteriorate from the time they are opened for traffic. Then, again, we know very well that two similar pavements laid down under similar conditions will frequently show a decided difference in endurance under traffic. The "personal equation" seems to enter as largely into pavement construction as into anything else, in spite of carefully-drawn specifications. Of no pavement is this more true than of a cement concrete pavement, and this being so one should be carefully guided between the extremes and means of the seemingly perfect concrete road and the apparent failure of this pavement in some cases. The facts relating to the details of construction should be required at each observation—and here one may note that it is regrettable in the interests of good pavements generally that advertisers and pavement promoters should indulge in so much anonymous disparagement of rival pavements without an abundance of facts.

An Anonymous Pamphlet

Some time ago, in common, probably, with a number of other engineers, the writer received a yellow-covered anonymous booklet entitled "The Good Road, and the Not So Good." This endeavored to show, and no doubt proved to the satisfaction of the author, the crass stupidity of some municipalities in laying concrete roads. There may have been some points of merit within the covers of the pamphlet, but unfortunately they were lost sight of when one noticed on closer observation the bar sinister, as it were, against the book in the fact that no one acknowledged its parentage, there being not even a printer's name on it. There is no doubt, however, that it was calculated to inspire doubt in the minds of those who had committed themselves to concrete pavements, and in some cases it probably had that effect. A nearby municipality, for example, had already started on the work of paving when one of these little yellow books came within the view of a lay member of the Council. Such an effect was made by it that some of the members seriously discussed the advisability of stopping the work at once. However, other counsel prevailed, and the work went on, the pavement went down, and it is there yet, and shows every likelihood of staying where it was put.

The first piece of road built in Oshawa was an 8-inch macadam, on a Telford base. This was estimated to cost 95 cents a square yard, and the actual cost by day labor was $1.01. It was well made, and, apart from the fact that it was alternately muddy and dusty and that it harbored dirt, it was in fair shape after two years. It then commenced to unravel, and had it been deemed good policy to maintain it, it should have been repaired at once—a circumstance with which we are all more or less familiar. In the meantime, however, tenders had been called for an extension of this class of roadway, it being thought that the work would be done cheaper by contractors than by day labor. We are all familiar with the opinion of worthy citizens who think that day labor by a corporation is robbery, forgetting that not infrequently contract labor by a careless contractor is jobbery. The prices received in these tenders for macadam ranged from 95 cents to $1.16 a square yard, the main reason for such prices being that broken stone had to be brought by rail at a cost of approximately $1.50 a cubic yard.

In the face of these tenders it was decided that macadam roads, with their consequent liability for maintenance, would not be a satisfactory form of surface for main streets in a busy town. Different high-class types of permanent pavement were adopted later for the leading thoroughfares at prices ranging about $2.50 a square yard. These pavements, while giving great satisfaction, cannot be continued to any great extent past property with scattered frontages, or on streets where property would not receive so high a valuation. To meet these conditions a plain concrete pavement was put down. It is believed that this was the first of its kind laid east of Toronto, and as it is on the Kingston Road, it is already doing its part as a link in the highway that is to connect Toronto with Montreal, of which we hear so much. This pavement being the first, and, moreover, being laid by contractors who had never before laid a pavement of any kind, has not the pink-of-perfection appearance that so many pavements exhibit on first acquaintance. It has defects which are interesting inasmuch as in the future they will be guarded against, but by the general public who use the road it is voted a sound piece of work. To confess some of these faults (for they are ever before the writer), it may be said that the surface is rather wavy, due to inexpert finishing, and the joints are not as regular as they might be. Impurities in the gravel, combined with the laitance from the cement, at first gave the road a scaly, blistered appearance, which, however, disappeared after a time. Now, the concrete pavement was laid down at a cost of $1.12 a square yard, including excavation, and gives all the comfort and ease of traction which may be expected from a permanent pavement. Moreover, its cleanliness is surprising, dirt and litter drifting to the uncurbed sides of the road, leaving a clean, white stretch of concrete twenty feet wide, extending for more than half a mile into the country.

The following year two similar pavements were put down; and here a point should be noted—that Oshawa has not been advised to go in headlong with concrete roads simply as a fad and because they are concrete. There is another reason. The comparisons of cost between macadam and concrete have already been shown. Another point is that the macadam pavement was paid for by the town in cold cash from current revenue, without any direct tax against the adjacent property. This was the cause of much bickering and jealousy on the part of the residents of other streets in the municipality. For the concrete pavement, however, debentures were floated, and the cost of the work is shared between the owners of property fronting on the work and the town—the property owners paying 60 per cent. in payments extending over twenty years, and the town 40 per cent. Thus you are able to put a proposition to the property owners on behalf of a pavement in this manner:

Will you, Mr. Property Owner, pay a tax of from six to eight cents per foot per year for a pavement passing your property?

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* Discussion of a paper on this subject (published in our last issue) by H. S. Van Scoyoc, Chief Engineer Toronto-Hamilton Highway Commission.

That is what the most expensive of our concrete pavements cost the property owner, and compared with the advantages received it must be conceded that the sum seems trifling. So you see that it is not the concrete fad, but a matter of practical dollars and cents. The only sound way for a town to finance its paving is on the frontage basis, and the period over which payments are extended should not exceed a conservative estimate of the life time of the pavement, and, of course, local traffic conditions would govern this. Then, again, all citizens use the main thoroughfares more or less, and so it would seem fair that all should contribute some portion of the cost as has been illustrated—say 40 per cent. by the town and 60 per cent. by the owners of adjacent properties. Once off the main thoroughfares, however, the cost should be borne wholly by the property owners, and, as has been shown, it is no very great amount in the case of such a pavement as we are discussing.

An Efficient Inspector Essential

Now, regarding the technical side of the concrete pavement. Too much care cannot be given to the selection of an inspector. It is a slow process, but every year some town is looking over its previous year's work with regret and realizing that the two-dollar-a-day, old and esteemed citizen who was put on as inspector has been after all a poor investment. Good intentions and an honest conscience are all very well, but for the sake of the pavement a municipality must appoint as inspector a man of good common sense and an honest understanding, based upon practical experience in the work in hand. Three or four per cent. of the cost of the piece of pavement is little enough to pay for competent supervision, but it can be done for that. The aggregate and cement are more or less staple, but the "personal equation" depends upon the competence of the inspector who is to have charge of the work.

Details of Practice at Oshawa, Ont.

So much information in the nature of specifications is common knowledge that only a few details of a practical nature that have arisen during the course of pavement work will be touched upon here.

In Oshawa the aggregate has been supplied by creek, pit, and lake-shore gravel. In the first road the stone was separated from the sand by screening, and then picked over and stones larger than one's fist removed. Where the subgrade had been excavated below grade the larger stones were pounded into the roadbed just ahead of the concrete. This plan, however, leads to confusion, and is not to be recommended. On other streets the gravel was screened as far as possible between the limits of 2 in. to ¼ in. A point worthy of notice is to take care, after the ingredients have been separated, that teams and workmen bringing up fresh material along the sub-grade do not raise a dust that will coat the surface of the stones and the heaps of sand ahead of the mixing outfit. Simple as it seems, this has been a source of serious defects.

It seems to be a more sound practice to have the subgrade flat, and, assuming the road to be 16 feet wide, to have the middle of the cross section seven inches thick and five inches at the side, rather than to have a uniformly crowned road surface six inches thick. The only danger with the flat sub-grade is that unless great care is taken it is likely to be hollow in the centre in some places and thus offer facilities for the retention of water. Close attention should be paid to rolling, particularly where any filling has been carried out. If the filling is much over six inches, there is no doubt that greater security is offered by the adoption of some reinforcing material. Wire mesh is suitable and very convenient for this purpose, although it of course adds somewhat to the cost of the finished pavement.

The Oshawa work has been carried out with a mixture having the proportion of 1:2:4, and with thorough mixing seems to give good results, although some authorities advise a proportion of 1:2:3, and even stronger proportions. A thorough mixing, however, covers any slight error there may be in the amount of cement, and to check this the number of revolutions of the mixer per batch should be frequently noted, and the contractor cautioned, if necessary, against "racing" the gang to finish out ahead of a previous day's work.

As a suggestion which would perhaps offer a wider field for discussion than is confined within the limits of this article, the writer would call attention to the possibilities of a new line of development in concrete road work. The application of concrete with an air compressor has been successfully carried out upon building operations. Attention has been called recently to an article in one of our journals* on the application of concrete to walls and such structures by high pressure, super-heated steam. Here, possibly, there is a wide field of endeavor and a new method of work offered to some enterprising contractor with capital in applying these principles of operation to pavement work.

The cement is getting to be more and more standard, but since to meet the needs of storage, or to expedite shipment, manufacturers find it necessary to vary the proportion of the several constituents, it is equally necessary for the cement user to make careful tests of this article. Personally, the writer is of the opinion that cement should undergo special tests showing its peculiar fitness for pavement work. Concrete in bulk is self-curing in time. Most other cement work is cared for in some particular manner that ensures at least the commencement of a process of crystallization before using. The cement pavement, which naturally has to endure severe shocks, should receive particular care as to its setting and hardening qualities. Let this most important ingredient be tested at the mills by an independent inspector. The fee for such work is not a heavy one, and the system is well worth while. The results of the 24-hour test will generally arrive at the work before the car, and so a guide as to the setting qualities of the cement is provided without holding up the job. Apart from the inconvenience and loss of time, if the cement is tested on the work and does not come up to requirements dissensions are sure to arise as to what particular sacks of cement belong to the defective car-load, and later there is always a chance of some of this creeping into service when supplies of cement run low.

Be sure that all finishing is done from a bridge or some temporary superstructure placed clear over the concrete. It has been stated that the only way to keep men off the concrete is with a stick, and indeed it does seem to require drastic measures. The evil of such traffic on the concrete is made apparent upon close observation. The sub-grade must be kept well wet ahead of the work.

The finisher should be working all the time within thirty or forty feet of the mixing gang; otherwise initial set of the surface may take place, or dust will settle and prevent adhesion of the surface particles after finishing.

A finisher should not be allowed to just smear a float over the surface of the concrete after the fashion of a house plasterer, but should exert reasonable pressure, and so close all voids in the concrete, smoothing the surface over afterwards to obtain the desired finish. This is particularly important on each side of a joint.

Joints are the bugbear of all makers or concrete pavements. In the Oshawa work only two thicknesses of tar-paper were used, these being first placed next to a steel partition plate, the soft concrete being closed on the paper after removal of the plate. Of the resulting joints it can only be said that some are very good, while others show that greater caution might have been exercised when withdrawing the partition plate or when floating the surface after the concrete had been placed.

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* See article "Mixing, Curing and Placing Concrete with High Pressure Steam" by Harold P. Brown, published in The Contract Record of March 10.

When a pavement is being laid by day labor no effort is spared by the staff having the work in hand to show a commendable piece of work. Perhaps this is the reason for the criticism so often levelled at day work, the pains taken being considered wasted effort. Now, however rigidly a specification may be drawn, there is generally some point not wholly adapted to the work in hand. The engineer, or the inspector after a conference with the engineer, should be allowed a certain degree of latitude in the adjustment of specifications while the work is in progress, for it is better to check an apparent fault at the moment of observation than to continue the work with a defect that might have been remedied.

Specifications should insist upon the provision of some satisfactory arrangement for keeping rain off the day's work. A succession of light trusses with canvas stretched between will shed the water and save much worry about rough pebbled surfaces, which it is impossible to make good and which induce wear from the first.

Any attempt to carry out concrete pavement work in winter cannot be too strongly deprecated. To all ingenious methods of heating ingredients, water, and so forth, the word "Don't" should be emphatically applied. The damage done by a succession of frosty nights is only too certain to upset all previous precautions even if the days are warm. As a measure against attempting to carry such work through to completion against such chances as are offered with uncertain weather, all specifications should contain a clause stating that work must be completed, or else cease, by, say, November 1st. It is all very well to take a chance with work that can be confined to a small area, but for superficial work like concrete pavement, spread as it is over such an extended area, the risk of frost must not be taken. The defects do not show at once, and regrets the following spring are useless.

Although the greatest defects in a concrete pavement are likely to show up within twelve months after construction, it is just as well to have a guarantee extending over a period of at least two years. This guarantee, to be of service to a municipality—and of course a fair guarantee is intended to strengthen the hands of the municipality—should be in the nature of cash held back out of money due to the contractor. If this amount is, say, five per cent. or ten per cent. of the value of the contract, and interest at a rate to be agreed upon is paid to the contractor, an assurance is thus given that if the work in question should prove defective the municipality will be able to make good such defects out of the money they retain, without having recourse to law. It is very difficult to secure redress when holding guarantee bonds, even if they are couched in attractive terms and are for large sums of money.

In the Edmonton Courts, the Bitulithic & Contracting Company, Limited, and Messrs. Warren Brothers, of New York, have obtained an injunction restraining the Canadian Mineral Rubber Company from using their patent paving process. In delivering judgment, Mr. Justice Hyndman found that the patent had been infringed and said that there was ample evidence that the Bitulithic process was a very useful invention, and that, according to evidence given by City Engineer Craig, it had given highly satisfactory results in Calgary.

The State Highways of New Jersey

By Robert A. Meeker, State Highway Engineer

THE first roads built under State supervision in New Jersey were of plain macadam, in the northern section of the State, and of gravel in the southern. For the first fifteen years, these roads were satisfactory; then the increasing motor-driven traffic imposed a stress too heavy for them to withstand. This forced us to look for something that would meet the new requirements as cheaply as possible. We first tried the so-called asphalt oils and tars. These were applied hot by means of an ordinary sprinkling wagon. This treatment stopped the ravelling of the surface, which had caused so much unfavorable comment, but the results obtained were not uniform; some sections were very good while others were not. This led to the practice of mixing the stone and bitumen before applying them to the surface. The results obtained by this method have been over ninety per cent. good, whether the stone has been heated before adding the bitumen to it or not. We learned the first year that weather conditions must be considered carefully, and that the best results were obtained during warm, dry weather. This has led us to place such a restriction in our specifications and to further prohibit the laying of bituminous concrete before the first of May or after the fifteenth of October, except by special permission. If this precaution is not taken, the pavement is sure to become wavy, uneven and often so porous that water enters and disintegrates it. The great object in the construction of bituminous and all other aggregate pavements is to reduce the voids to the least possible quantity and at the same time to make a pavement as nearly homogeneous as possible; that is, the pavement must be as dense as possible and the mineral aggregate must be uniform in size and evenly distributed through the entire mass. To secure these results, the material must be carefully graded before it is mixed, must be evenly spread upon the road and uniformly compacted. As all of these factors are essential, it is very evident that the men employed, not only in the mixing, but also in the spreading and rolling of the material, should be skilled in their work if the desired results are to be obtained. These remarks apply also to Portland cement concrete.

No one pavement can be selected as the best for all places and all classes of traffic. The pavement to be used on a certain road must be designed to carry the present and prospective traffic. It must be constructed as cheaply and as durably as possible in order that the first cost, plus that of maintenance, may not be too heavy a burden upon the community. Having these principles before us, we must first ascertain what road building material is to be found along the line of the proposed improvement and utilize it as far as it is possible, with due regard to the ultimate economy. For example, a softer stone on a light travelled road will yield as good returns on the investment as a hard, tough trap on a heavy traffic road, and often at a saving of forty per cent. on the first cost. This principle has guided us in New Jersey from the very first. As a result, we have ten million square yards of water-bound macadam (principally in the northern and central districts), over six million square yards of gravel in the southern and seashore districts, and two hundred thousand square yards of oyster-shells along our bays. Each of these has served its purpose well, until increasing traffic has so augmented the cost of yearly maintenance that it has become necessary to change the type of wearing surface, the old pavements serving as a foundation for the new, thus obeying the old injunction of cutting our garment according to the cloth.

The wisdom of this practice is proved by our experience, which is as follows: The assessed valuation of all of the property along a certain road was based on the then farm values. Five years later the assessed valuation had increased five millions of dollars. The reasons for this were twofold: first, the improved road enabled the farmers along its line to haul four times as much over the road as before, and in less time, thus greatly reducing the cost of transportation and by this means increasing the profits and consequently increasing the value of the land; second, the improved road induced people seeking country homes to purchase land and erect residences along its line. Thus, as the travel increased, the necessary funds to maintain the road increased without increasing the tax rate. This is the logical method of road improvement as viewed in New Jersey. Therefore, for the entire State we have no one standard type of pavement, but rather as many kinds as we have varieties of material and weight and intensity of traffic.

As we are situated between the two largest cities on the Atlantic seaboard, our main highways are subjected to a heavy and constantly increasing traffic. This has forced us to resurface many of our old stone roads with bitumen, either as a surface application or in the form of a concrete. One million square yards have received such a surface treatment, while one million more have been paved with bituminous concrete. In addition to this, twenty thousand square yards of concrete have been laid, and of this over fourteen thousand square yards were treated with a bituminous paint coat.

A great deal of work has been done toward improving the alignment on our old roads. Sharp turns that have been the scenes of many collisions have been eliminated, and the roadway, at road intersections, has been widened, thus greatly reducing the probability of accidents. In fact, a large portion of our work on old roads has been done with a view to promoting the safety of the travelling public. Alignment and grade are two factors that are becoming as important in highways as on railroads. The saving in cost of maintenance and the promotion of the safety of travellers are demanding and receiving far more attention now than ever before.

Mainly Constructional

East and West — From Coast to Coast

The F. W. Thorold Company, Limited, 2 Toronto Street, Toronto, have been appointed Consulting Engineers by the Town Council of Port Hope, Ont.

The Thirty-fifth Annual Convention of the American Waterworks Association is to be held in Cincinnati from May 10 to May 14 next. The Secretary is Mr. J. M. Diven, of Troy, N.Y.

The Vancouver Marble and Tile Company's plant at Vancouver was damaged by fire recently at a loss of some $10,000. The loss is represented by damaged marble-cutting machinery.

At Saskatoon, the York Building, which has cost some $50,000, is practically finished. The building is two storeys high, of brick construction. The architect is Mr. A. J. Illingworth, of Moose Jaw.

It is interesting to note that an item of $135,000 has been replaced in the estimates by the Toronto Board of Education for the Administration Building which is to be erected on College Street, Toronto.

An important feature in the Ontario Legislature last week was the introduction by the Hon. Finlay Macdiarmid of a Roads Bill marking the launching of the thirty million dollar road programme of the province.

That the West is not altogether dead is evident from a report from our Vancouver office to the effect that three thousand men will be required this month for construction work on the Hudson's Bay Railway. The officials of this line are looking forward to a "record construction year."

The enterprising little town of Redcliff, Alberta, has a municipal programme which entails the expenditure of $230,000. Of this amount $190,000 will go for work on the sewerage system, while $35,000 will be spent on the water-works. Garbage collection and disposal represent an expenditure of $6,000.

The Vancouver Harbor Commissioners have been notified from Ottawa of the passing of an Order-in-Council granting forty-two acres of tide flats in False Creek for reclamation purposes. We understand that the general details of the project have been mapped out, and that the work is to be put in hand at an early date. It is the intention to lease the reclaimed area for industrial sites.

British Columbia, it appears, is enjoying an early spring this year, and in consequence a great deal of road work is under way much earlier than usual. The province has a comprehensive programme, which will be put in hand as soon as the necessary local arrangements can be made, the scale of wages which prevailed last year being paid.

The Northern Agency and Equipment Company, Port Arthur, Ont., dealers in builders' supplies, have taken Mr. Philip Labbe into the firm. Mr. Labbe is well and favorably known at the head of the lakes, and he should prove a valuable acquisition to the company. Mr. R. W. Burgess, who organized the company over a year ago, remains General Manager.

At Hamilton, Ont., the local architects and engineers have formed a club with the idea of erecting quarters in the near future. The following gentlemen have been elected to office in the new Club: Mr. E. P. Colman, President; Mr. W. Stewart, First Vice-President; Mr. J. J. McKay, Second Vice-President; Mr. E. F. Kelly, Secretary-Treasurer; and Mr. Lawrence Munro, Director.

Members of the Montreal Builders' Exchange recently visited the local Technical School, and inspected the engineering, woodwork, iron work, and mechanical departments. The members also had the opportunity of seeing the pupils at work in the iron work and mechanical departments. The methods of instruction were explained by the directors of the school.

The amended plans of the Burrard Inlet Tunnel and Bridge Company for the construction of the Second Narrows bridge, are to be forwarded to the Provincial Government at once, with a request for a definite statement as to whether further aid will be given. The British Columbia Government has promised $400,000, and the Dominion Government a subsidy of $350,000. The company want the province to guarantee their bonds up to $500,000. The total amount subscribed to the project, including the government guarantees, is $1,500,000, the other amounts being as follows: District of North Vancouver, $400,000 (of this amount $62,500 has been transferred to the Municipality of West Vancouver); City of North Vancouver, $150,000; City of Vancouver, $200,000.

The fourth annual banquet of the Chatham Builders' Exchange was held the other day, and it is pleasing to report that it was a most successful function. Among those present were Mr. A. E. Flower, Secretary of the Toronto Builders' Exchange, and Mr. T. Wright, President of the London Builders' Exchange. The chairman of the evening was Mr. William Robertson, of the local exchange.

From Prince Rupert, B.C., comes the report that the great new dry dock in that city which is being built under the supervision of William T. Donnelly, of New York City, will be completed in May, and that ships will be docking there regularly this summer. The machinery which has been installed for the expeditious handling of cargo includes a heavy electric crane with a lifting capacity of 65 tons.

The bridge which is to span the Bulkeley River in British Columbia, and which is to be erected by the Provincial Government, is to be 576 feet long. The structure will consist of four 144-foot spans, carried by heavy piers. The road-way is to be 14 feet wide. Coast fir is to be used in the construction, The Hon. Thomas Taylor, Minister of Public Works, has been unable to comply with the request that the bridge be constructed this spring, it being impossible to place the material on the ground in time.

Much interest has been aroused along the waterfront at Victoria, B.C., by the preliminary development work now in progress on the old Indian reserve. The area of grading operations for the common-user right of way goes back to the old hospital site. Much rock work is being encountered. Two grades are being prepared at the north end and both of which are to connect with the new Johnson Street bridge —one for the overhead road and the other for the footway beneath. The men are being worked in gangs of about 175 each.

Mr. J. H. Plummer, President of the Dominion Steel Corporation, reports that while the rail business has been dull, operations at the company's Sydney plant are proceeding at sixty per cent. of the total capacity, and that the prospects are bright for a continuation of the same scale. The latest development in the steel industry is an advance in steel prices in the English market. This is of particular importance to the Dominion Steel Corporation, seeing that with the exception of the steel required in connection with shell-making contracts, the firm's entire output is being shipped to English or French concerns.

Mr. C. A. P. Turner's latest revised plans for the Second Narrows bridge at Vancouver have been sent to Victoria for submission to the provincial authorities. At a meeting of the board some time ago it was decided to forward the designs immediately and to renew the request for Government assistance, by financing bonds to the extent of $500,000. Sir Richard McBride had previously intimated that the Government's attitude with reference to further aid towards the enterprise—a subsidy of $400,000 has been promised—was contingent upon the bridge company's submitting designs satisfactory to the executive.

Professor Burgess, of the University of Alberta, gave a lecture at Calgary recently on the subject, "Modern Architecture." The speaker said that architecture was still the expression of the people's life as it had been all through the ages, but that the complexity of modern conditions and the inventions of the last century had greatly increased the responsibilities and problems of the architectural practitioner. Greek and Roman architects had made a lasting name for themselves, and after all the design of the forum, or some other such structure, was comparatively simple compared with the design of a modern city hall, or governmental headquarters. Modern conditions called for a great variety of buildings—railway stations, clubs, swimming baths, banks, office buildings, hotels, factories and technical schools. Professor Burgess illustrated his remarks by a series of lantern views, which included the magnificent railway stations of New York, Washington and Paris; famous buildings of all kinds in old London; governmental buildings and banks in Canada; New York City sky-scrapers, and last—but not least—Toronto's new technical school.

Personal Mention

Messrs. Arthur and Hubert Soucy, of Montreal, have registered as Messrs. A. Soucy & Cie., general contractors.

Mr. Charles E. Parry, Town Engineer of Fort Frances, Ont., is serving with the Third Canadian Contingent as a Lieutenant in the 52nd Battalion.

Mr. W. A. Rogers, representing among others the Toronto Pottery Company, Limited (fire brick, sewer pipe, etc.), has opened an office at 301 St. James Street, Montreal.

Mr. Joseph Race, City Bacteriologist of Ottawa, gave an illustrated paper on "Slow Sand Filtration" at a recent meeting of the local branch of the Canadian Society of Civil Engineers.

At a recent meeting of the Ottawa Branch of the Canadian Society of Civil Engineers Mr. H. A. Powell, K.C., St. John, N.B., read a paper on "Railroad Construction and the Public." Mr. Powell is a member of the International Joint Commission of Canada and the United States.

Mr. H. A. Bayfield has been appointed Principal Assistant Engineer at Fort Nelson, the terminus of the Hudson Bay Railway. The appointment was made by the Dominion Government. Mr. Bayfield was formerly Superintendent of Government Dredges in British Columbia.

An interesting talk on the construction of the Bloor Street Viaduct, Toronto, was given before the Toronto Branch of the Canadian Society of Civil Engineers on March 25 by Mr. T. T. Black, Engineer in Charge for Messrs. Quinlan and Robertson, the contractors for the Don section of the viaduct.

John Gemmell, R.C.A., a Toronto architect, died last week at his home at Swansea, Ont. The late Mr. Gemmell was a native of Ayrshire, Scotland, and was brought to Canada early in life by his parents. He was an Associate of the Royal Canadian Academy, and a former President of the Ontario Society of Architects.

Mr. J. L. Skene is the new President of the Vancouver Builders' Exchange. He is supported by the following officers: First Vice-President, Mr. J. G. Anderson; Second Vice-President, Mr. A. G. Brown. Directors, Messrs. W. M. Horie, J. O. Perfect, T. Borgford, D. H. Wilkie, C. T. McPhalen, J. Tucker, T. G. Bird, W. C. Greer, R. H. Gale, W. N. O'Neil, A. P. Bogardus, H. C. Douglas, J. Bain, F. A. Worth, and W. O. Marble. Secretary, Mr. W. Hamilton-Lindsay.

The following gentlemen have been elected to office in the new Engineering Society established in connection with the Faculty of Engineering at the University of Saskatchewan. The elections took place at a recent meeting of engineering students held in Saskatoon. Mr. F. T. McPherson, President; Mr. H. S. Smith, Vice-President; Mr. James Murray, Secretary-Treasurer. Mr. G. J. McKenzie is

The Iona Gypsum Company's mill at Iona, N.S. (Note the proximity of the water. The splendid location and the facilities for shipping by both water and rail are features of this plant.)

Honorary President, and Mr. John P. Oliver Honorary Vice-President.

Mr. J. J. O'Gara, of Calgary, has been elected President of the Alberta Association of Architects. The other officers are as follows: Hon. President, Mr. Jas. Henderson, Edmonton; First Vice-President, Mr. Richard P. Blakey, Edmonton; Second Vice-President, Mr. G. H. MacDonald, Edmonton; Hon. Secretary, Mr. W. G. Blakey, Edmonton; Hon. Treasurer, Mr. W. D. Cromarty, Edmonton. Council, Messrs. G. Fordyce (Calgary), R. W. Lines (Edmonton), R. P. Barnes (Edmonton), C. L. Gibbs (Edmonton), C. S. Burgess (Edmonton). Representative on University Senate, Mr. Jas. Henderson, Edmonton.

From Messrs. A. C. Leslie & Company, Limited, of Montreal, we have received a copy of an interesting publication issued by Messrs. John Lysaght, Limited, of Bristol, Eng., manufacturers of corrugated iron products. This publication takes the form of a souvenir booklet, containing a list of the firm's employees on service and also a Roll of Honor of those killed, wounded and missing. It is significant of the Old Country's response to the call of the Empire that from Messrs. Lysaght's works alone 1,449 have gone on active service, and from their office staff, 67 men, making in all a quarter of the total hands employed by the firm. The publication reviews the causes of the war, and certain of the developments in connection with it, while the prefatory portion closes with a word of cheer in respect to the manner in which the bonds of Empire have been cemented during the last few months.

The Growing Importance of the Gypsum Industry in Nova Scotia

Quarries and Plant of The Iona Gypsum Company, Limited

A growing industry in Nova Scotia, and one that bids fair to become a most prominent one, is the mining of gypsum, large deposits of which are found in this province, particularly in Cape Breton.

In 1912 the Iona Gypsum Company, Limited, with their head office at Sydney, secured choice gypsum properties two miles from Iona, on Big Bras d'Or Lake, forty-five miles from Sydney, and started manufacturing this product. Today they are not only supplying the Canadian market, but large shipments are being made to different foreign markets. It is found that the gypsum mined at their quarries is of sufficiently fine texture to compete with the foreign-made, and particularly the German, material.

The company have a practically inexhaustible supply of gypsum in their deposits, an expert estimating it conservatively at twenty-five million tons. The material coming from these deposits is of the finest quality mined. In fineness of texture and pure whiteness it compares favorably with anything on the market at the present time.

A most important feature in the company's operations is their splendid location, they having both rail and water shipping facilities. They are directly on the main line of the Intercolonial Railway, and are also at the water's edge, where vessels of almost any tonnage can be brought right to their docks, which are only 75 feet from their warehouse. To meet their water shipping requirements they have erected

General view of The Iona Gypsum Company's quarry and mill, showing proximity of quarry and mill.

a warehouse right at the dock with a capacity of 1200 tons for bag goods, and have put in a loading equipment consisting of a 30-inch conveyor belt with capacity of 200 tons of crushed rock or 100 tons of bag an hour, making it possible to load the largest vessel in a few hours.

The quarries are in close proximity to the plant and the docks, the farthest end not exceeding a distance of 1300 feet from the mill, and being practically at the water's edge.

The plant is a most modern one, the mill being equipped with two 10-foot calcining kettles. The crushing plant has a capacity of thirty tons an hour, and the calcining plant a capacity of 200 tons every twenty-four hours. Power is derived from two 125-h.p. boilers and one 250-h.p. engine made by the International Engineering Works, Limited, of Amherst, N.S., and in addition a 50-h.p. electrical plant supplies the electric lighting system and the small auxiliary drives in different parts of the plant. An air compressor plant near the engine room operates the hammer drills in the quarry. In addition to this equipment there are blacksmith, machine and cooper shops.

The company have in charge of this plant as Superintendent, Mr. Chas. Vermaud, who is an expert in the gypsum business, having had over nineteen years' practical experience in United States and Canadian mills.

Interior of calcining plant at The Iona Gypsum Company's mill.

Mr. N. M. McNeil is the Managing Director, and Mr. D. G. O'Connell the Secretary-Treasurer of this progressive firm, which is rapidly winning favor with the trade by its high manufacturing standards.

The contract for practically the entire construction of the Mormon Temple at Cardston, Alta., has been obtained by the Kootenay Granite & Monumental Works of Nelson, who has been at work on the material for the substructure of the building for more than a year. The temple is being constructed entirely of Kootenay granite, obtained from the quarry of the Kootenay Granite & Monumental Works at Three-Mile Point, Kootenay Lake, from which, during the last year, sixty carloads of granite have been taken to Cardston. The construction work on the temple will extend over a period of two years more. The building is being financed from the Mormon headquarters at Salt Lake City. When completed the temple will have over $250,000 worth of stonework in it and will have cost altogether more than $500,000.

Editorial Miscellany

In an address before the Bureau of Municipal Research last week, Mr. W. W. Pearse, City Architect of Toronto, made some interesting observations concerning the work and reorganization of his department. He emphasized the importance of knowing the carrying capacity of soil, and said that a civil engineer had been engaged exclusively for this work. In regard to the By-law, Mr. Pearse said that he proposed to have it divided into Chapters, giving Residences, Theatres, Apartments and other buildings a chapter each. In this way it would not be necessary to wade through the entire Act to look up a single point. Each volume will be bound separately.

* * *

In the quiet city of Guelph, Ont., there is at least one optimist, in the person of Mr. R. D. Stewart, of Robert Stewart, Limited. Mr. Stewart tells us that the building prospects for the season are particularly bright with his firm. Already they have signed contracts to supply the materials for twenty-one residences in various parts of the city, whereas at this time last year they had only contracted for fifteen. They have a number of good contracts for outside work, also. Further, Mr. Stewart tells us that his firm has been working eight hours a day all the winter. Recently they closed down for a week in order to effect repairs to the machinery, but now they are starting in again at full time with a staff of sixty-five men.

* * *

Mr. F. L. McPherson, Municipal Engineer of Burnaby, B.C., read a paper, "The Kingsway Paving," before a recent meeting of the Vancouver Branch of the Canadian Society of Civil Engineers. He said that a review of the conditions under which the great highway between Vancouver and New Westminster was made, convinced one of the urgent need of the centralization of authority, both for constructional and administrative purposes. Along Kingsway there were four different types of paving, variously designed and all constructed at different periods by four separate authorities. Such an inter-urban highway was not only of local but provincial scope and usefulness, and it should have been constructed and administered by a highway commission composed of representatives of more permanent bodies. It was intended to publish Mr. McPherson's paper in this issue of The Contract Record, but it is held over owing to pressure of space. We hope to abstract it in a later number.

Among the several problems to be met with in the recent construction of the concrete reservoirs in San Francisco, Cal., was that of bonding asphalt to concrete. According to B. N. Abbott, in a letter to Engineering Record, after making unsuccessful attempts to apply the asphalt directly to the concrete in various ways, the expedient of first painting the surface with coal-tar was tried; and it was found that when applied in this way under right conditions, the asphalt would adhere so firmly that after it had cooled it could not be broken away without bringing pieces of concrete with it.

Mr. Abbott states that in order to secure this result, the concrete surface was first scrubbed clean with a bristle brush, and over this a thin coating of hot coal-tar was "painted." The coal-tar should be heated in small quantities, brought just to the boiling point, and then applied immediately. Heating the coal-tar in large quantities, which necessitated some delay before it could all be used, did not give such good results; and the gangs were therefore not allowed to heat more at a time than they could apply quickly as soon as it began to boil. The asphalt was spread over the tarred surface in the usual manner.

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Contractors and Manufacturers in City Councils

OF many curious anomalies that one meets with in city councils and other administrative places where people talk much and do little—dancing, perhaps, to the tune of some lean-witted lawyer—the most curious is the need for men qualified to express an opinion on structural matters, and the lack of appreciation when such men are found. Once in a while an engineer, or perhaps the head of some important constructional industry, accepts office in a council, but as surely as he does he comes in, not for the general run of criticism that flesh is heir to, but for irritating insinuations repeated every time he takes part in a recommendation which involves the use of structural material.

During the last few months we have heard a great deal about the respective merits of reinforced concrete and steel in bridge work. In the course of the discussion that waged around the Bloor Street Viaduct at Toronto—now being built of steel—many of the statements made reflected upon men in office whose positions and experience at least qualified them to deliver an opinion one way or the other. What else would we have? Surely a man with a mind, and the experience, must arrive at a decision! He cannot be qualified equally well in all branches of constructional enterprises, and naturally he adduces arguments in favor of the work or material that he knows best. One who had seen the famous reinforced concrete bridges of Italy, France, Germany, or, nearer home, the United States, might not turn to steel as the solution of such a problem as the Bloor Street Viaduct; but, on the other hand, the man with the practical experience in the properties and cost of steel bridges would put up an argument in favor of this construction so strong that only expert opinion could award the palm to either.

We are impelled to this article by hearing of the experience of a well-known man in the steel trade, who, when he learned that the architect had decided to take tenders for a reinforced concrete bridge, had the temerity to stand up in the city council of which he was a member and suggest that alternative tenders for both reinforced concrete and structural steel should be obtained. Immediately the local press waxed furious, characterizing the steel man's attitude as "unfair and improper." Needless to say, the arguments adduced in favor of this statement did not fail of supporters. There is always a following in the wake of the muck-rakers.

If we persist in this attitude we shall bring our city councils to the pass where their membership is composed of men whose principal qualification is total ignorance of constructional matters. This will be a nice

A Passing Thought From Kipling

**"Comfort, content, delight
The ages' slow-bought gain,
They shrivelled in a night,
Only ourselves remain
To face the naked days
In silent fortitude,
Through perils and dismays
Renewed and re-renewed."**

state of affairs in a country concerned mainly with its material upbuilding.

Surely it is possible for a steel man to stand up on his feet and deliver himself of some of the experience of his own trade calculated to redound to the advantage of the citizens! In the case to which we have referred the suggestion was only that alternative tenders should be called, instead of tenders for reinforced concrete alone. In this instance alternative tenders would have engendered more competition, and doubtless would have resulted in a saving of money.

A man should not be elected to a city council unless his character will bear the most searching investigation. His integrity should be unquestioned, and his attitude toward any material, at all times, like Caesar's wife, must be above suspicion. Once elected to office the civic fathers are entitled to a measure of confidence, and in any case they are entrusted with the affairs of the city, and no insinuations will reform them if they do lend themselves to dishonesty.

The Handwriting on the Wall—"Build Now"

A pamphlet received from the Stinson-Reeb Builders' Supply Company, Limited, Montreal, is headed by the suggestive words "The Handwriting on the Wall'—Build Now and Save Money." The words remind one of the handwriting on the wall which appeared to King Belshazzar a part of the interpretation of which, it will be remembered, was "Thou art weighed in the balances and art found wanting."

The reminder should stand as an awful warning to those who are deferring the hour of building. The warning has been given and the interpretation thereof has been published several times in these columns. Build now, because labor is plentiful; build now, because material is at rock-bottom price; build now, while the real estate boosters are out of business; build now, while competition among contractors is the keenest ever known; build now, when all conditions combine to ensure good profits when the War is over; build now, when the greatest and truest patriotism which non-combatants can show is to contribute their bit to the stability of the country's business.

Belshazzar was weighed in the balances and found wanting, and his kingdom was divided among the Medes and Persians. During the whole period of this great war Canada is being weighed in the balances. If we are not to be found wanting we must take an active part in promoting every constructive effort. We have the opportunity. Are we going to take it, or are we waiting for the Medes and Persians?

The handwriting on the wall—"Build Now."

It is unfortunate that the vilifications of the press and of the man in the street are generally directed against the few good men that a council possesses. With what result? That the "few good men" finish up their term of office, get out, and never get in again.

Generally speaking, the councils of our larger Canadian cities are by no means creditable to the country. Men become aldermen, and succeed to the office of Mayor, without any better qualification than an ability to sound their own trumpet and play upon the sympathies of the local press. If we were asked to support the candidature of a busy man high in reputation and with years of experience in contracting and public works of all kinds we should jump at the chance; but the opportunity seldom comes: this type of man will not stand for the criticisms and insinuations which are becoming inalienable from office in city councils.

We venture to say that a city council or board of control comprised entirely of contractors and manufacturers would make a more businesslike job of administering a city's affairs than Canada has ever known. And not only would there be greater efficiency, but greater honesty. The very fact of their acceptance of office would impel them to give the city a square deal.

We return to this subject again, even at the risk of wearisome reiteration. Though our editorial sallies roll off like water, we shall continue to give them from time to time—in the hope that the drips we contribute will be added to the continual process which is known to wear away stone.

Changing Plans on the Contractor

If a contractor makes a unit bid under certain conditions, and the owner's engineer changes these conditions in such a way as to render that bid and the whole contract unprofitable, is that justice to the contractor? Strictly speaking, it is not. But is the contractor entitled at law to recover damages from the owner? Under certain circumstances, which are decided by a jury, he is not entitled to recover, and ought not to be, if we are to have any coherence in our legal system.

The questions are suggested by a recent decision in a suit which contractors for a reservoir at Seattle brought because the city's engineers changed grades on the work, necessitating extra excavation. The contractors claimed that their bid on excavation was unprofitable, and was made only in connection with a bid for refilling gullies at the reservoir site, which refilling had been eliminated by the change of grades.

A contract must be interpreted by the intent of the contracting parties as set forth in the contract instrument, of which, in the case of construction contracts, drawings and specifications form a part. If there is ambiguity in the instrument, testimony on the ambiguous point may be introduced as evidence of the original intent. In most cases—and the court indicates that this is one of them—it is not a matter of common understanding between the contractor and the owner's engineer which schedules in the contractor's unit bids are expected to prove profitable and which unprofitable. Obviously, it is not just to bind the owner to a feature of the contractor's bid with which the owner and his engineer were not acquainted at the signing of the contract, and which contractors generally have considered as no concern of the owners. As elsewhere in the contract in question right was given the owner's engineer to make those changes in the plans of which the contractor complained, the court could in common justice do nothing but dismiss his suit.

Such decisions mean in the end an economic loss to owners, however, for contractors are forced to make higher schedule bids, lest they be involved in loss through a change of plans by the owner's engineer. This is a strong argument for changing the present system of unit bidding and contracts made under that system. This may be done in two ways.

First, the czar-like power conferred in present contracts on the owner's engineer to change any feature of the plans and specifications after it has become part of a contract should be curtailed. In no other class of contracts known to law is such an advantage allowed to one contracting party without a corresponding concession to the other. The time when owners and engineers need to take unjust advantage of contractors to safeguard owners' money and engineers' reputations against mistakes of the latter is passing, and the legacy of these conditions incorporated in nearly all construction contracts should pass with it. This is said with full appreciation of the strength of clauses and contract forms which have withstood the shock of court proceedings and which should not lightly be tampered with. Common justice, however, is of more importance than hallowed contract forms.

In the second place, where full determination of a design, which it is desirable to make a part of the main contract, must await some preliminary construction work, the contractor should employ competent legal as well as competent estimating talent to guard against losses such as occurred at Seattle. In a case of this kind, the owner should be made a party to those schedule bids likely to be affected by a change in plans, and permission given the owner's engineer to change the contract only after a readjustment of such schedules satisfactory to both parties has been arranged. In other words, there should be incorporated in every contract liable to change a clause providing that the consent of both parties must be obtained before a change is made.

The law sometimes finds itself in the position of having to enforce one-sided contracts; but such contracts are offensive to the best legal minds. Doubtless many a judge has been disgusted with the awards required of him by ill-drawn construction contracts. Vesting power to change contracts in the engineer, on the ground that he is a third party, sounds very fine in theory, and is a quibble which the best courts in the land have discovered no way to challenge; but the practice is contrary to all principles of justice, since the interests of the engineer and owner in a change of contract are almost always identical. We venture to say that legal minds will rejoice with the contractors when this anomalous power vested in the engineer is stricken from construction contracts.—The Engineering Record.

Highway Development in British Columbia

Specially contributed by Hon. Thomas Taylor, Minister of Public Works for British Columbi

BETWEEN the year 1908 and the present time the province of British Columbia has constructed, at a cost of some $23,000,000, over seven thousand miles of highway work and some two thousand two hundred miles of trail. This is apart from the work done in this direction by the various municipalities. In addition to this the highway system of the province has been maintained in good order during the whole time. There are in British Columbia to-day fourteen thousand two hundred and eighty-four miles of highway, much of which has been graded to a width of 16 feet, surfaced, and brought to such a condition as to afford ample facility for automobile traffic throughout nearly the whole province.

The last few years have witnessed a keener and more intelligent participation in the Good Roads problem by people generally throughout the world, and particularly by the people of British Columbia. With regard to this province, the immense territory to be opened up (over four hundred thousand square miles), the present sparse settlement, the extremes of climatic and physical conditions, and the fact that settlement and development do not spread gradually or systematically from different centres, render the development of an adequate highway system both difficult and costly.

The recent and very great increase of railway mileage in this province has necessitated the construction of many new roads, and the repair and improvement of all existing roads leading to the railways, in order to bring our rural produce as close to the market as possible.

As has been the case in other parts of the world within the last few years, the increase in the number of automobiles, and especially of self-propelled commercial vehicles of the heavy type, has been so great as to constitute a serious menace to road maintenance. So great, indeed, has the burden caused by these vehicles become that stringent legislation governing their use of provincial highways has had to be passed by the local legislature. Such restrictions on traffic, however, must ultimately have an adverse effect on rural districts. It is realized that under normal conditions highways can be constructed economically to carry horse-drawn or automobile traffic alone, but it is quite apparent that in a very short time British Columbia must face the problem of constructing a trunk road system at considerable expense capable of carrying a combined traffic of a heavy type.

One of the greatest factors in governing the first cost and the cost of maintenance of a highway system is the general level of the land with respect to the subsoil water-table. In the vicinity of such rivers as the Fraser and its tributaries—the Squamish, Cheakamus, Lillooet, Columbia and Kootenay—very great expense has had to be borne by the Provincial Government in carrying out works for the exclusion of flood waters and for the draining of its road beds and for public works generally.

A very great deal of dyking, river improvement or other protection work has still to be done, and unless this is carried out on an adequate and comprehensive scale the cost of highway work will be prohibitive.

Apart, however, from the physical conditions of construction, the cost of highway building in this province is governed largely by the local labor market. It is unconstitutional to employ convict, statute, Oriental, or other cheap form of labor on any public work, as the province must pay the current rate of wages in each locality where works are being carried out.

While full advantage has been taken of such machinery as is suitable for road building, the initial cost and the cost of maintenance of provincial highways in British Columbia is necessarily much higher than in any other part of the Dominion. The cost of labor (while to a certain extent governed by the cost of living and consequently the cost of transportation) is dependent largely on local conditions; thus civic and municipal authorities invariably adopt a higher wage standard than private corporations. Oriental labor, because of its cheapness, has been sought after to such an extent that the wage has risen, with a consequent rise in the cost of white labor, which, of course, is higher. In mining districts wages for labor are influenced by the high standard of the union wage for miners. In logging districts common labor is also correspondingly high. In agricultural districts roadwork usually has to be carried out at a time when farmers cannot afford to leave their land for other work. Thus it is apparent that the labor market for road work is very limited, and as those who participate in road building generally have some land and small private means of their own the wages demanded are high. With the exception of Italians and some Scandinavians there is no class in British Columbia whose vocation is purely unskilled labor, and until such a class exists the cost of highway construction here must be considerable.

Very great thought and care is being given to the mapping out of what will be ultimately a great trunk road system for the whole province. At the present time the surveys and investigations in connection with this are being prosecuted diligently. It is felt, however, that this is a matter of such importance to the ultimate prosperity of the province that it should be given very special and careful consideration.

The backbone of the scheme as outlined at present consists of a trunk road running generally north and south through the province and another road or other roads running east and west. It is proposed to connect up these with the Great Pacific highway in the United States and the Transcontinental road of the Dominion of Canada. In connection with both of these undertakings the provnice has up to the present time set a splendid example to other countries by the extent and quality of the work that has been completed so far.

In conclusion it may be said that while many countries are suffering from the present financial stringency, British Columbia is in the very fortunate and proud position of being able to carry out its scheme of public works development without reduction.

THE damage caused to concrete structures by electrolysis, owing to the corrosion of metal embedded therein by stray currents of high voltage, has been found to be productive of very serious effects, which it is believed can be minimised by the insistence by the architect or engineer on the use of properly-made paints on the surfaces of such metal. A variable series of experiments made by Mr. Henry A. Gardner, the Assistant Director of the Institute of Industrial Research, Washington, D.C., is communicated by him to the March issue of the Journal of the Franklin Institute. The conclusions arrived at are that the vehicle of such paints should contain: Boiled or bodied oils, or products which dry to a fairly saturated film. Oils which dry by semi-polymerisation rather than oxidation. Oils which dry to a flat rather than a highly gloss surface. The solid portion should contain a percentage of: Pigments which are coarse, and which therefore tend to form films having a rough surface. Pigments which are inert and which do not act as conductors of electricity. Pigments which are either basic or of the chromate type. The painted metal should be "sanded" if possible.

Estimating the Cost of Culverts and Other Small Structures in Road Building

THE contractor or engineer whose experience in the construction of roads in country districts has been limited is prone to error in estimating the cost of culverts and other small structures, comments Engineering and Contracting, editorially. In the aggregate the sum of the cost of these features seldom exceeds ten per cent. of the total cost of the job. But in point of effect upon the progress of other portions of the work, and hence the cost of other work, error in estimating cost or arrangement of construction work may affect total costs very materially.

The two most important cost producing elements in building small structures are transportation of materials and the difficulty of working small and widely separated gangs. The former is affected by the condition of the roads—usually bad—and the frequent necessity of traversing a section of recently graded road or road in process of being graded, in the case of culvert construction. This results in decreasing the size of loads that may be carried and limiting the type of transportation to horse drawn vehicles. The latter element practically forces the employment of extra foremen or the use of highly paid and reliable workmen to secure effective work in the operation of small gangs.

The work that must of necessity be done by small gangs is varied and, as a rule, extends over the whole period required for the completion of the job. It includes the moving of fences, grubbing stumps, building temporary roads, digging trenches and laying pipe culverts in advance of grading operations, building concrete culverts, constructing temporary bridges, trimming and finishing, laying gutter, erecting guard rail, and numerous other small jobs, usually at widely separated points.

In estimating the cost of such work it is therefore generally wise to become thoroughly familiar with the ground before figuring the probable cost. It is also advisable to estimate such work from the labor cost gang basis rather than attempt to use unit costs, although it must be admitted that the amount of work necessary in so doing is out of all proportion to the relative cost of the work. It is certainly convenient to estimate that concrete culverts will cost so much a cubic yard of concrete or guard rail so much a linear foot, but is it not wise to consider the number of culverts and their location and the number of different points at which guard rail is used? When these elements are considered the amount of labor must be computed or unit costs increased by estimate to secure a proper bid, and which is the safer method of estimating?

Experienced contractors are familiar with the uncertainty of the cost of these small structures, and their bids upon such features are generally quite high. A loss upon them, however, usually does not affect greatly the total cost of the work. But it is a matter of some satisfaction to remove the uncertainty as to the cost by more careful methods of estimating than it is the practice of some contractors to employ.

The Black Bay Bridge at Port Arthur. This bridge has a clear span of 136 ft. It is built on the Kahn system.

The Construction of Bridges and Culverts

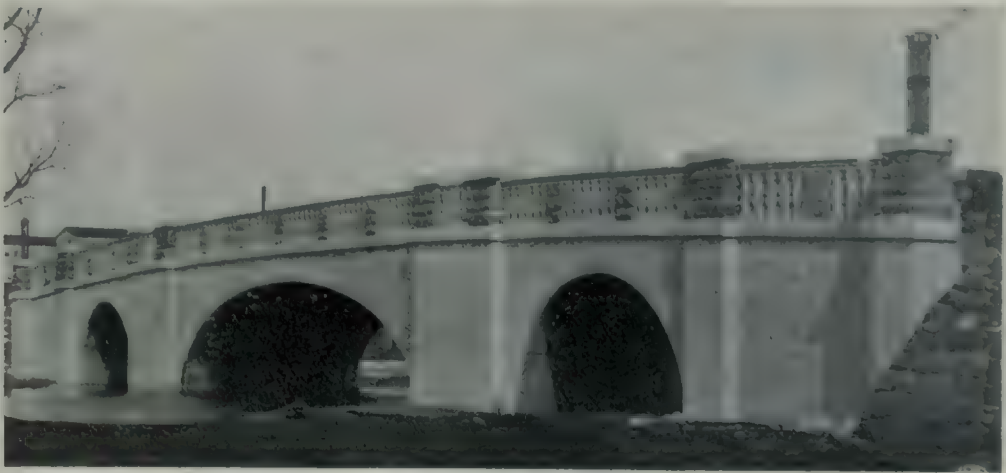
By Lucius E. Allen, Belleville, Ont.

THE important question of the development of a good roads system, which is now so prominently before the country, necessarily includes the construction of good bridges and culverts. Since a road is only as good as its weakest point, it is obvious that a poorly constructed bridge, as an integral part of the road, has much to do with determining its value in service.

It may be of interest to trace briefly the development that has taken place in bridge construction during the last fifty years, more especially in regard to the kinds of materials which are being used in the construction of bridges. When this country was first settled, and even until quite recently, wood was the most easily procured and commonly used material for building bridges. Wooden bridges of various types were constructed, many of which are in use still. Traffic conditions at that time did not require as strongly constructed bridges as at present, and the old wooden bridges served their purpose as well as those built of any other material.

Some twenty-five years ago the use of iron in combination with wood and otherwise came into use, iron having become cheaper in price and more available, as well as being more adaptable to the heavier type of bridge construction. The most common type of iron bridges are the simple girder and pin connected trusses, with all-wood floor systems. It was not, however, until about the year 1875 that steel as a bridge-building material came into use, and then it was employed only in heavy or long-span bridges. As the manufacture of steel was rapidly developed and cheapened, its use as a material for bridge-building increased rapidly, and to its use credit must be given for the construction of some of our largest and most important bridge structures. At the present time steel is the principal material entering into the construction of a large number of our bridges.

The use of cement or concrete as a bridge-building material, while of almost ancient origin, did not become general until some years ago. Plain concrete arch bridges were constructed in France nearly fifty years ago, and they are still in good condition. Within the last fifteen years, however, the use of concrete reinforced with steel has rapidly developed into one of the most flexible and permanent materials yet discovered for bridge construction, and while not adapted to all locations or conditions must be considered one



The Guelph Prison Farm Bridge.

of the most important factors in the development of modern bridge-building.

It is not desirable at this time to enter into an explanation or discussion of the theory or technic of the designing of either steel or reinforced concrete bridges, but rather to refer to some of the general and practical features of the subject which are presented almost daily to our municipalities. Returning to our first axiom—that an improved highway is only as good as its weakest part—we see that it is essential in considering any highway improvement to make a careful study of the traffic and general requirements in connection with that highway, including as a component part the bridges and culverts. It seems essential, therefore, in carrying out any general or special highway improvement to first adopt some general plan for handling the work. This rule should apply equally to the construction of a system of permanent bridges in a township or county, but a systematic survey of all the existing bridges and important culverts in the municipality should be made first. Such a survey, I would suggest, should cover the following points:—

1. A complete list of all bridges and important culverts in the municipality, giving the name of each bridge, its location, type of construction, character of river or stream, foundation conditions, present condition, when last painted or repaired, and rating.
2. A classification and rating of such bridges, based on amount and character of traffic conditions.
3. The embodying of all this information in a general report to the council of the municipality, with such recommendations as may be thought necessary in dealing with the question.
4. An inspection of all bridges and culverts, and revision of such original report each year thereafter.

Such a survey may appear to some to be a heavy task and not productive of sufficient results to warrant the time and money spent on it; yet if it is once made properly the future work of the municipality in this respect will be lessened immeasurably. From the data secured from such a survey and report the total approximate cost of reconstructing and renewing a permanent bridge system in any county or township may be calculated.

Too much stress cannot be placed on the responsibility of municipal councils in allowing old and unsafe bridge structures to remain until an accident occurs involving loss of life or property, and if a "stock-taking" in the way of a general bridge survey and report were made available each year to the public the tendency to delay the reconstruction of old and unsafe bridges and culverts would be reduced to a minimum, and claims for damages would disappear. That this question of responsibility has been brought to the attention of the authorities in other places is evidenced by the publication of a report by the U. S. Bureau of Roads of an inspection of the highways of the State of New Hampshire, in which Mr. Charles H. Hoyt, C.E., says:

"Attention is called especially to the condition of the numerous wooden culverts and bridges on the State road. . . . . These culverts and bridges are subject to a large traffic through the summer season, and practically every one of them is unsafe. It seems that it would be a better policy to rebuild and replace these wooden deathtraps with reinforced concrete structures once for all than to wait until some horrible accident has happened, resulting in the loss of life and claims for heavy damages, which may amount to as much or more than the cost of concrete culverts, and have to build such culverts after all these things have happened." These are strong words, but they only reflect the true situation existing in many of our Canadian counties and townships.

Assuming that a definite survey and bridge report of the condition and desired improvements of a given municipal bridge system has been prepared, the next step is to consider the best and most economical plan of carrying out the proposed work. The best plan to be adopted in any given municipality will depend largely on the number and the character of the bridges to be constructed. If the case be that of a large county or township, having a large number of bridges and culverts to be constructed, extending over a period of years, a county or township bridge construction force, organized and directed directly by the council through qualified officials, may carry out the work better and more economically than could be done by any other method.

Where a county has already organized a competent bridge construction force it would be quite feasible for the county force to undertake the construction of any bridges and culverts under township control when requested to do so by any township in that county, the actual cost of labor and materials for the township bridge work being charged against the township, thereby saving it the initial cost of purchasing equipment

The Fairfield and Ross Bridges (County of Hastings, Ont.) comprising three 95-ft. steel spans and one 20-ft. reinforced concrete span. Erected at a cost of $13,940.

The Tempe Bridge in the State of Arizona. This bridge, which was built by prison labor, is 1507 ft. 9 in. long and has an 18-ft. roadway. It has 11 spans. The cost was $118,920.

and organizing a township construction force. Especially is this the case when most of the proposed work is of reinforced concrete construction. It must not be inferred from this, however, that any less skill or care is required in building bridges of this type than those of structural steel, careless workmanship and poor design having been productive of many failures. If suitable machinery is provided, and a careful selection is made of materials such as gravel, sand or crushed stone, and competent foremen and workmen employed, excellent results should be obtained, and a large proportion of the money expenditure for labor and materials will be distributed and will return eventually to the ratepayers of the locality.

There seems to be, also, an increasing use in many countries of prison labor for work of this nature. One of the best examples of a large bridge constructed by prison labor is that of the Tempe Bridge in the State prison labor is that of the Tempe Bridge n the State type of reinforced concrete, with an eighteen-foot roadway with open spandrel walls and a total bridge length of 1,507 feet. In this work the State, as an incentive to the prisoners to good behavior and efficient work, allowed each prisoner for each day employed on the bridge a credit of two days off his sentence in addition to the usual good-time allowance. Possibly some of our German, Austrian and Turkish prisoners of war in Canada could be made useful in this way.

If bridge work in a municipality is not carried out directly under its own forces, but by public contract, the plans and specifications should be carefully prepared by the municipal engineer in accordance with the Government regulations, and close inspection of the work throughout should be made during construction and on completion.

The decision as to the type of bridge to be built for a given locality, whether of steel or of reinforced concrete, will depend largely on local conditions. If a steel construction type is selected, the length of the bridge may determine whether a high truss or low truss, or a girder type, is best adapted to the requirements. The number of spans should be so governed in most cases that the total cost of the superstructure will be about equal to the total cost of the substructure or foundations.

In any case it is considered the best practice to put down a reinforced concrete floor slab. This will vary in thickness from 5 to 8 inches at the crown, and from 4½ to 6 inches at the edge. The addition to the concrete mixture for bridge floors of a small percentage of high calcium hydrated lime will increase notably its density and durability. In long span bridges it is also a good plan to spread on the finished floor surface a good covering of gravel, which in winter serves to hold the snow better than a smooth surface, and in addition protects the concrete from excessive wear.

A very noiseless and efficient floor covering may be obtained by the use of creosoted wood blocks. This will add from $2.50 to $3.50 a square yard to the cost of the floor system, but for cities and large bridges it may be considered very desirable.

Most careful attention to the selection and application of protective coatings of bridge paint to steel bridges should be given, as the life of the bridge will depend largely on its being kept painted thoroughly. Many steel bridges in this county are rapidly going to ruin for the lack of attention to proper painting, both before and after erection.

That the intelligent use of reinforced concrete as a material for bridges and culverts has reached a high state of development needs no comment, and where there has been one failure, due to improper design or the use of poor materials, there are hundreds of satisfactory and permanent examples of reinforced concrete bridges and culverts which are fulfilling every condition required of them. Several points occur to the writer in connection with this type of bridge construction which he has found from experience to be worth following:—

1.—Do not attempt the work because it looks easy. Skill, experience and care are required to secure good results.

2.—Do not spare time and money in selecting first the best aggregate available—gravel, sand or crushed stone.

3.—Do not use too lean concrete mixtures. Sufficient cement is more economical than poor work.

4.—Do not slight the work of mixing and placing the concrete. This is often the cause of failure in a bridge.

5.—Do not place the reinforcing steel carelessly, and see that every piece of steel is in its place.

6.—Do not slight the form work. Good carpentry work is essential to a well-finished bridge.

7.—Do not pour slabs, beams or arches when weather conditions are unfavorable, but when weather conditions are favorable push the work forward to make it as near a homogeneous monolith as possible.

8.—Do not sacrifice strength and durability to beauty in either design or workmanship. A combination of both can be had without injury to either.

9.—Do not strip form work too soon, or allow traffic on the bridge until it is well cured. This has caused the failure of many bridges which otherwise would have been satisfactory.

10.—Do not build bridges with too narrow roadways, or for too light loads.

The construction of culverts is very closely allied to that of bridges, and in general the same principles apply. A bridge of less than ten-foot clear span may be considered a culvert. The best type of construction to use for any particular culvert will depend on local conditions. The height way be such that a reinforced concrete slab resting on two abutments will be the better type to use. Many small culverts are being built by the use of collapsible steel forms which may be removed quite easily. Where the foundations are not of the best a continuous base upon which the abutments may rest may be used to advantage. If it is thought that scouring will take place, a concrete tie foundation wall connecting the two abutments should be carried down and transversely with the culvert to such a depth as will prevent under-washing.

Reinforced concrete tiles can now be manufactured in large sizes, and in many cases may be made use of in the construction of permanent culverts. They should be carefully laid and bedded, the joints being well cemented and finally covered to a sufficient depth.

All-metal culverts of galvanized iron are also used in many localities, but where conditions are favorable for putting down concrete culverts they are no doubt more permanent than metal.

The naming and marking of all important bridges is a small detail, but one which adds to the convenience of inspecting and reporting on and locating any particular bridge for all time. Bridge plates have been adopted in Hastings County. They cost the county $5.00 a pair, and one plate is placed on each right-hand end post of every reinforced concrete bridge constructed. They are made of bronze, and make a permanent marker.

Good Roads at Toronto—A Picturesque Boulevard in the Humber Valley

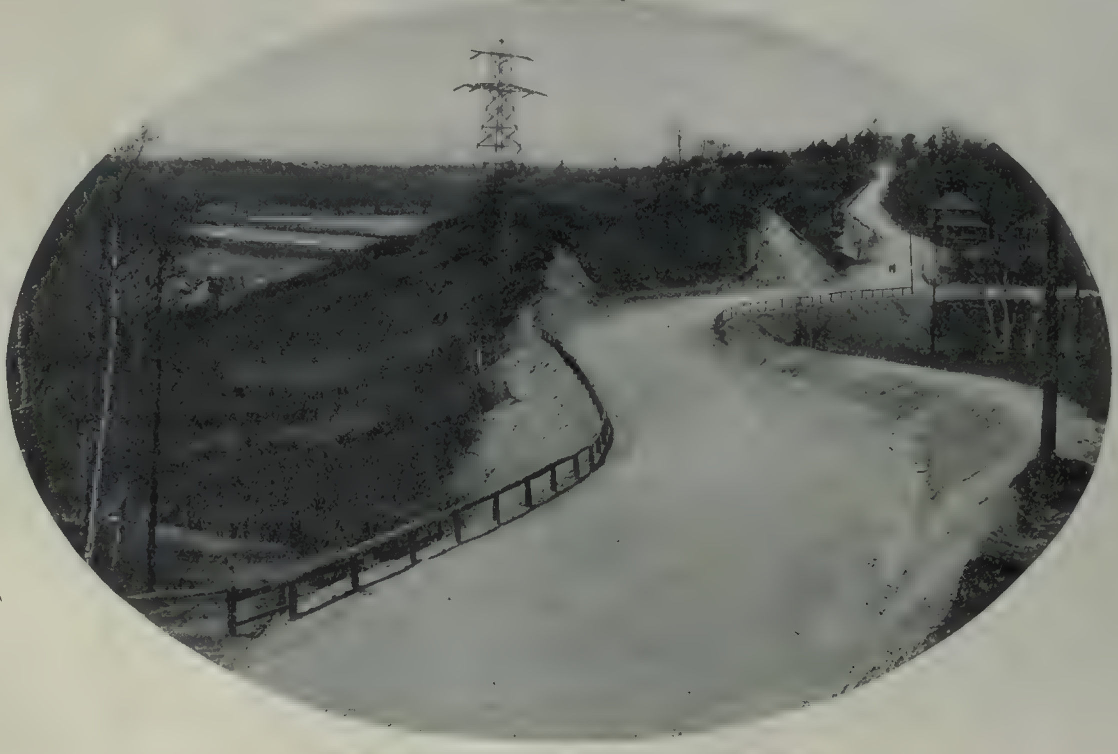
WHAT good roads mean to Toronto—which of all cities of Canada is a motoring community—is well illustrated in the accompanying views, which show the transformation in the Humber Valley effected by the building of the Humber Boulevard.

This boulevard is a picturesque driveway on the outskirts of Toronto, winding its way northwards from the Lakeshore Road. Upon its final completion it will afford a beautiful road from the lake shore to Lambton.

The greater part of the Humber roadways are constructed of Rocmac, and the reader cannot fail to find interest in a brief description of the materials used, and the methods employed in the construction of this class of highway. This type of road is composed of a mixture of hard rock, limestone dust and Rocmac, a concentrated mineral binder which, when thoroughly set, gives the surface of the road a wear-resisting quality which prevents ravelling and rutting and holds the crown of the road perfectly, even on steep grades. The Rocmac binder is an odorless, colorless liquid, shipped in barrels or tank cars, and is ready for use without heating or other preparation.

There are two methods employed in the construction of the Rocmac roads, namely: the pressure system and the mixing system. The latter method was used on the Humber roads. By this method the proper proportions of Rocmac mineral solution, limestone screenings and the broken stone of the top course, are mixed together into an aggregate, which is then spread as usual, and rolled with a ten or twelve-ton, three-wheeled roller, until the matrix or mortar comes up through the interstices of the stone.

The pressure method is sometimes looked upon more favourably than the mixing system, but local conditions on the Humber roadways made the latter method more efficient and economical. Briefly, the



The Humber Boulevard, looking north from the lake-shore.

Unimproved track—shown below in the finished road.

pressure system consists of the following operations. On a suitable foundation, a stiff mortar or matrix, composed of fine limestone screenings mixed with the Rocmac binder, is spread evenly to a sufficient depth to completely fill the voids of the wearing course. The usual top course of crushed stone, preferably two-inch, is spread over this matrix layer to whatever depth is sufficient to give, after a thorough rolling, the desired thickness for the wearing surface. The road is then rolled with a ten or twelve-ton roller until the matrix comes up through the interstices of the stone.

The base course of the Humber Rocmac roads consisted of six inches of crushed limestone, well filled with sand from the sides of the roadway, watered and thoroughly consolidated by rolling. Generally speaking, the thickness of the broken stone base will vary to suit the particular conditions of sub-grade soil and traffic requirements. It is understood, however, that any existing sound road-bed—such as a worn-out water-bound macadam—may be used for the foundation. The Rocmac construction throughout is always simple, and can be accomplished under any ordinary conditions of labor and materials.

The Humber Boulevard.—Bloor Street, looking north from Jane Street. On an average seven motors a minute spin along this road.

On the Humber Boulevard the Rocmac is standing up well under the heavy traffic, and practically all the new construction, including the road at the river level from Bloor Street to Lambton, will be of this type.

The Rocmac now in use has been down two years, and is giving excellent service. Its initial cost is comparatively small, while the cost of maintenance is negligible.

The popularity of the boulevard is attested by the fact that in a one-hour count on a Sunday afternoon recently, four hundred and twenty automobiles passed.

Good roads men visiting Toronto should take a run out to the Humber Boulevard, and drive over one of the best roads through one of the best bits of scenery, in Eastern Canada.

No sand which contains small particles of coal or lignite should be used for the outside finish of any concrete, although sand of this character may be used in the interior portion of heavy pieces of concrete work. The sand for exterior surfaces should be of a bright, uniform color.

"One of the best roads, through one of the best bits of scenery, in Eastern Canada."

Rapidity of placing concrete where quick-setting cement is used is a point which must be carefully attended to. Some cements obtain their initial set in about ½ hour after being wet. A slow-setting cement should be used when a long time is likely to occur between mixing and final placing.

Prof. C. H. McLeod, of McGill University, and Secretary of the Canadian Society of Civil Engineers, has been chosen President of the Intercollegiate Amateur Athletic Union.

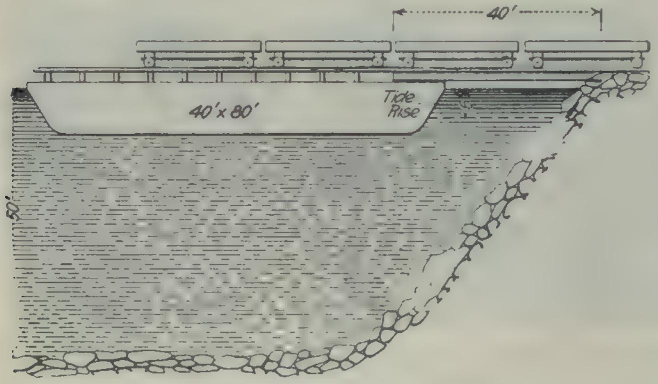
Mr. J. G. Sullivan, Chief Engineer for the Western Lines of the Canadian Pacific Railway, has been elected Second Vice-President of the American Railway Engineering Association.

Messrs. Fraser and Chalmers of Canada, Limited, are removing their head office from 4 Phillips Place, Montreal, to 59 Beaver Hall Hill, Montreal. The removal has been found necessary owing to the requirements of greater space brought about by the increase of their business.

Dumping Bridge for Building an Embankment in Tidal Water at Halifax, N. S.

PART of the extensive harbor work now going on at Halifax, N.S., is a rock-fill breakwater in 50-ft. maximum depth of water extending 1,500 ft. out from shore. This is being constructed by Cook Construction Company & Wheaton Bros. The same firm has a contract for taking out two very large rock cuts in the line of the new railway approach to the new wharf and pier district which the Government is building. The material taken out of these cuts is in large part used for building the breakwater; the rest of it is being deposited as fill in building out the shore line to the new shore front bulkhead or sea-wall. The total amount of material in the cut is 2½ million cubic yards, practically all of it rock. About 250,000 cu. yds. is in the breakwater, distributed as follows: Core, fine material, 147,000; sea slope, large material, 56,000; harbor slope, 25,000; paving, stone blocks, 15,000.

The depositing of material for the breakwater is being done by a very interesting method devised by the contractors. A floating apron is used as a dumping-bridge in spite of tide effects; water ballast keeps the apron scow at constant level. A plate-girder bridge 40 ft. long is mounted at its forward end on a barge 40 x 80 ft. and its rear end rests on four or five cross-ties laid on the outer corner of the embankment.



Sketch of dumping bridge arrangement.

The spoil, brought along in 16-yd. dump cars, is dumped directly from this bridge. Three or four cars at the head of the train are run on the bridge, dumped and returned. The track is continued across the scow as a tail-track.

The tidal rise is about 6 ft. To keep the bridge level, water-ballast tanks are provided in the scow; these are pumped full as the tide rises, and pumped out on the fall of the tide, keeping the dumping-bridge level with the embankment.

When the embankment has been built up high enough (4 ft. above mean water) in the space spanned by the bridge, the scow and bridge are simply hauled forward until the bridge comes to a new bearing on the new outer point of the embankment and the process is continued. About 1,300 ft. of the breakwater has been completed.—Engineering News.

Costs per capita for the several parts of the sewage-treatment plant at Fitchburg, Mass., were given by David A. Hartwell in a paper before the Boston Society of Civil Engineers. As the matter of excavation depends upon the location and conditions, and would vary widely, Mr. Hartwell has eliminated all such cost in the following figures. The cost of the five Imhoff tanks was $52,224, which, based on a population of 55,000, would be about 96 cents per capita. The cost of the sprinkling filter, 2.14 acres in area and from 10 to 10½ ft. deep, was $122,990, or $58,847 per acre; based on a population of 40,000, the cost was $2.94 per capita. The cost of the sludge-drying beds when completed will be about 5 cents per capita. The cost of the secondary tanks was $8,426, or about 15 cents per capita for a population of 55,000. The cost of the dosing tank was $9,436, or 17 cents per capita. When completed the disposal works will cost about $320,000, including cost of land, buildings, roadways and incidental work not including engineering and inspection. The cost of the latter has been 8½ per cent., which would add $27,200 to the cost, making $347,200, or $6.31 per capita.

Detecting Water Waste[*]

THE municipal water plant of St. John's, Newfoundland, was recently studied by F. F. Longley, of the firm of Hazen, Whipple & Fuller, consulting engineers, the municipal board of that city having found that the supply and pressure were apaprently becoming inadequate. The average amount of water supplied to the city was found to be 166 Imperial gallons per capita per day, based on the total population, or about 300 gallons per capita per day based upon the population connected with the distribution system. This, of course, meant excessive waste of water or leakage from the distribution system, and an effort was made to discover, in a general way at least, what was responsible for this condition.

No appliances for measuring waste which would give the best results were available, and two different methods were employed with the equipment available. With one of these, the variations in the rate of leakage from an entire district which had been isolated by the closing of valves were estimated from the drop in pressure as the water passed through a long line of fire hose through which the supply to the district passed from the distributing system outside. This was a preliminary step only, and showed in what districts to look for large waste and a rough approximation of the quantity of leakage therein.

With the other method, a meter was used on the hose line through which the water was discharged into the isolated district. Readings on the meter gave indications of changes in the rate of flow, down to the limit of sensitiveness of the meter used. This was used to follow up the first method, and resulted in a much closer localization of the waste.

Three districts were examined in this way and excessive waste found, of which it was concluded that 75 to 80 per cent. was in house services and the balance in the mains. As the remedy for this condition it is recommended that meters be installed as rapidly as the finances will permit, beginning first with the largest consumers and those where the greatest leakage is suspected. On the basis of $12.50 for a ⅝-inch disc meter installed complete, and with allowance for a few larger meters, this would require an expenditure of $10,000 a year for five or six years.

In connection with examination for distribution of waste, a night inspection of all service cocks in the city was instituted by applying the key and determining the presence or absence of sound of water flowing through the service pipe. Where any such sound is detected, this service is inspected the following day and house fixtures examined for leakage, notice being served on all consumers whose service or fixtures may thus be found leaking, and followed up at the end of a reasonable time by another similar inspection. "The sound of water at the key always indicates a flow of water. It is possible for it, however, to be either in the house, in the service pipe or in the main, and every means should be used to localize this before going to the expense of digging up either the service or the main.

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[*] From the Municipal Journal.

"The night inspection by sound at the cock should be repeated periodically. So long as meters are not used on all services, this is the only means of detecting a great deal of the waste. I would suggest such an inspection at least three times a year, to cover the entire city. Each of these periodical inspections must be followed up by a secondary inspection where waste has been found."

"It is not possible to find and suppress all of the waste. The cities which have devoted most attention to the measurement of and the accountng for the water supplied, with every service metered, still show in a general way from 15 per cent. to 30 per cent. of the water unaccounted for."

Maintaining Bituminous Surfaces[*]

Construction Engineers Should Have Charge of Maintenance—Applying Paint Coat to Macadam Roads—Materials and Methods Used

ORGANIZATION is an essential feature of good maintenance. The maintenance organization should not be separated from that of the construction, as separate organizations are apt to result in an overlapping of jurisdiction and a tendency to shift responsibility. It is obvious that the logical organization to maintain a given system of pavements is the one that saw them laid and is familiar with every detail of the construction, as very often a knowledge of apparently trivial conditions in connection with the construction bears an important part in the future maintenance. Moreover, where the construction organization is not charged with responsibility for the maintenance, there is bound to be a subtle influence which will in a measure result in this division taking little or no active interest in the pavement after it is completed.

It is the intimate knowledge of details of both construction and maintenance, not considered separately but in their relation to one another, that is so desirable as a guide in highway engineering. Construction and maintenance are dove-tailed together and cannot be considered separately, either as to their physical characteristics or their cost. Even street cleaning should be considered a part of the maintenance work which should come under the jurisdiction of the highway department. In fact, in an older city where a large percentage of the streets have already been paved, the maintenance problem predominates and requires the greater part of the attention of the department.

There is always a tendency among engineers to be lax in attention to details of an apparently simple and routine nature. They are apt to overlook the fact that it is no trick to construct a pavement, as in supervising this work they are simply following more or less standard and well-defined principles; but in maintenance work there is no set specification to follow, and the success depends upon attention to detail routine and principally to petty details that present themselves in the actual physical work, and in this there is an unlimited field for initiative. Personal experience in observation of wear and pecularities of the different types of pavements and road surfaces is invaluable as a guide in research work, as there is not a pavement to-day that cannot and should not be improved upon.

For convenience the different branches of maintenance are classified as: 1, routine maintenance; 2, general maintenance; 3, emergency maintenance.

Routine maintenance includes regular street cleaning and other work of this character that should be performed under a definite schedule.

General maintenance includes repairs and involves different kinds of work, each requiring special knowledge on the part of those engaged in the actual performance of the physical work for which special gangs have to be organized. For instance, stone block, wood block and brick repairs require skilled laborers who have made a specialty of this work; while repairs to asphalt and bitiminous pavements must be performed by men specially skilled in this line of work. The usual subdivision includes these three classifications of block pavement: bituminous pavement, and macadam, bituminous surface treatment and earth roads. The best work requires a separate organization for each of these, made up of men specially trained in that particular branch of work. But the character and amount of the work is of such indefinite quantity, which can be performed only in seasons of the year when weather conditions are suitable, that it is difficult to maintain a good-working organization.

Emergency maintenance consists of such work as snow removal and taking care of extensive washouts, both of which require an emergency force, since it is necessary to put on an indefinite number of men, depending upon the volume of work, usually for only a short period of time. This means that the organization must keep in touch with all the available sources from which men can be employed on short notice.

Bituminous surface treatment is really the newest problem in highway maintenance, and it might be well to outline a method which has been in successful use on this class of work for several years. It is assumed that such surface treatment will be performed only on macadam roads that are thoroughly shaped up and have received proper compression under rolling and traffic, and that the traffic which they carry is suitable for this kind of treatment, namely, largely automobile and not too heavy in volume. If the theory could be carried out of applying a paint coat each year, to be covered with chips or gravel which will not form a pad, which necessitates patching and is apt to push and roll under traffic, this would be the most desirable method of applying bituminous surface treatment. This theory has been successfully carried out and has almost indefinitely prolonged the life of the pavement; incidentally solving the dust problem as well.

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[*] Abstract of paper before the American Association for the Advancement of Science, by William H. Connell, Chief of the Bureau of Highways and Street Cleaning, Philadelphia.

The amount of material Philadelphia uses in these treatments is about two-tenths to five-tenths of a gallon to the square yard; the first application usually requiring one-half gallon, the second year one-third, and after the third year about two-tenths of a gallon to the square yard. The method of applying the surface treatment is as follows: First, the surface is thoroughly swept with horse-drawn and hand brooms until all the fine material has been removed and the surfaces of the stones are exposed. The bituminous material is applied by either an automobile or a horse-drawn pressure distributor at the rate of two-tenths to five-tenths of a gallon to the square yard, depending upon the requirements in each particular instance. The portion of the roadway treated is then closed to traffic for about twelve hours, after which a light layer of stone chips free from dust, or of fine washed gravel is spread. The quantity of chips or gravel used varies from 15 to 18 pounds to the square yard, depending upon the character and quantity of bituminous material applied. After the gravel or chips have been spread the road is open to traffic.

The city has used both tar and asphalt cut-back in this work, the former for a number of years. The asphalt cut-back, however, has been used in Philadelphia for three years only, and has worked out very satisfactorily and will continue to be used somewhat extensively in this year's work, the tar treatment also being used.

The specifications for asphalt cut-back cover the naphtha, the asphalt and the combination of the two in the proportion of 35 per cent. by weight of naphtha and 65 of asphalt. The naphtha has a specific gravity of 53 deg. to 55 deg. Beaume. The asphalt has a specific gravity of 1.02, and a penetration of 140 to 160 for 100 grams for 5 seconds at 77 deg. F., and not less than 40 for 200 grams for 1 minute at 32 deg. F. The specifications for Ugite, both cold application and hot application, for Tarvia A and Tarvia B are given, which specify the specific gravity, free carbon, viscosity, melting point and distillation.

The relative costs of these different treatments, as described above and including cleaning and applying the material, are as follows:

New treatments, using one-half gallon of bituminous material and sixteen pounds of washed gravel or chips; using Tarvia B, 7 cents per square yard; using Tarvia A, 7.7 cents; using cut-back, 9.3 cents.

Retreatment, using an application of one-third gallon of bituminous material and sixteen pounds of washed gravel or chips; using Tarvia B, 5.4 cents; using Tarvia A, 5.9 cents; using asphalt cut-back, 7 cents; using Ugite (cold), 5.7 cents.

The difference in cost between the new treatment and retreatment is occasioned not only by the different kinds of material used, but also by the cost of cleaning and sweeping. Sweeping for the new treatment cost 2.2 cents, and for the retreatment 1.4 cents per square yard.

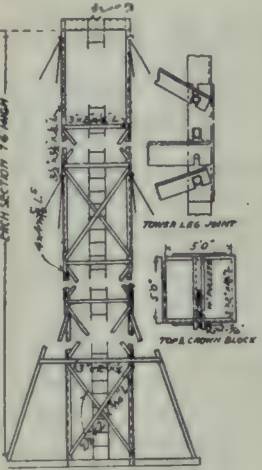
The cost of materials and labor was as follows:

Gravel, $2.14 per ton on the road; chips, $2.30 per ton on the road; Tarvia B, 7 cents per gallon applied; Tarvia A, 8½ cents per gallon applied; asphalt cut-back, 11 2-3 cents per gallon applied; Ugite, 8 cents per gallon applied; foreman, $100 per month; assistant foreman, $3 per day; laborers, $2 per day; machine sweepers, $5.50 per day; teams for hauling, $5 per day.

Even allowing for the high prices paid for gravel, chips, etc., these costs are somewhat higher than they should be, because the men and many of the supervising force were unfamiliar with the class of work. It is expected to obtain lower costs this year.

Concrete Tower Designed for Rapid Erection

An appliance for the convenient handling of concrete is illustrated by the accompanying sketch, which represents a steel construction tower introduced by a Chicago firm. The tower is built up of sections of 7 ft. 6 in. high by 5 ft. square, an essential feature being the adoption of slots in place of bolt holes for the connecting joints. Thus the sections can be put together or taken apart rapidly without the removal of bolts and nuts, as the slots permit the disengagement of the sections as soon as the nuts are slackened. The two bottom sections are braced as shown so as to form an extended base 15 ft. square in plan, and it is stated that the tower can be erected up to 200 ft. in height. The sheave beams are supported on a 10-in. channel bar on each of two opposite faces at the top of the tower, and the top frame can be fitted on the end of any tower section, in place of the horizontal struts and succeeding sections. All parts are interchangeable with the exception of the bottom legs, which are provided with special slots fitting the corners of the base. Ordinary sections weigh 500 lbs. each, and the base section weighs about 800 lbs. approximately. It is stated that three men can erect a 100-ft. tower in six hours and dismantle it in four hours, under average conditions.



Details of tower.

Telephones and Planning

The announcement of telephonic conversations between San Francisco and the principal cities of the eastern coast of the American continent, during which the human voice is said to have been heard for a distance of 5,000 miles, calls attention to the advance that is being made in the practical application of an invention whose possible influence on the placing and the arrangement of buildings, and on the whole question of the development and general lay-out of urban areas, does not appear to be generally recognised. It is probable, however, that this influence will be very considerable where convenience of arrangement and intercommunication are concerned. Yet, so far as we are aware, neither our architects nor our town planners have made any serious study of the subject. The "Influence of the Telephone on the Planning of Large Buildings" would make a good title for a paper at an ordinary meeting of the R. I. B. A., or for an essay or a thesis in connection with the examination. But possibly the telephone will ultimately exercise its greatest influence over the lay-out of cities and of manufacturing or of residential areas.—The Builder (London).

Long-distance telephone conversation across the continent was inaugurated recently, when Dr. Alexander Graham Bell, in New York City, talked to

Thomas A. Watson, his former associate in the invention of the telephone, in San Francisco, Cal. It was these same two men who held the first telephone conversation over a two-mile line, between Boston and Cambridge, Mass., October 9, 1876.

Fraser River Crossing of the Kettle Valley Railroad

THE combined highway and railway bridge across the Fraser River near Hope, B.C., on the Kettle Valley Railway, about eighty miles east of Vancouver, consists of four spans, each 140 feet long, and two 30-ft. highway approaches at each end. The steel is fabricated, and is being erected by the Canadian Bridge Company, Limited, of Walkerville, Ont., Superintendent S. H. Young being in charge. It is an unusually heavy bridge, as it was thought necessary at first to erect it by the cantilever method. Three of the spans weigh about 680 tons apiece, and the fourth, which is designed so that it may be converted into a draw span if ever it should become necessary to do so, weighs about 740 tons. All the spans are 31 feet deep and 20 feet wide, centre to centre of chords. The top deck will be planked over for use as a highway, while a railroad track runs through on the lower deck.

At the last moment before starting the erection, owing to the fact that the water was much lower than had been expected, it was decided to put the bridge across on staging. This proved to be a rather difficult task, for the water was over 55 feet deep in one part of the river, with a current of about eight miles an hour. No reliable soundings were to be had, and it was very difficult to judge the depth of the water correctly.

Four cables were stretched from pier to pier—two upper ones, and two lower ones about four feet above the surface of the water. Timbers were placed across the upper cables for the workmen to stand on, and a large scow was held by the lower ones. A large 20-ton derrick car, one of the newest and most efficient types, lowered the piles one at a time into the water. They were held in place by ropes from the upper timbers and also from the scow below. As soon as all the piles were placed they were driven, and after they were capped and braced the stringers, floor beam and lower chord were placed. Then, by the simple scheme of pulling the upper timbers and the scow out for a panel length, all was in readiness for another bent. In the fast water two rails were used on each pile. After the floor system and lower chords had been placed for one span the other members were put on; then, while this span was being riveted, the next one was started.

Heavy steel work in the construction of the bridge across the Fraser River.

The large derrick car was assisted by a lighter one, which acted as a feeder for the other. There is a large heavy rock cut at the end of the bridge, which necessitated the unloading of the steel at a considerable distance from the site. A large air compressor car, capable of supplying eight gangs of riveters and an air drill with air, was kept on a siding near the bridge.

Constructional progress on the Fraser River Bridge.

Construction trains will be able to go over the bridge about February 10th, and it is expected that the bridge will be completed about the middle of March.

The Right Idea

THE remarkable success attending the flotation of the $49,000,000 4½ per cent. loan of the Pennsylvania Railroad, which, according to best reports, was more than five times oversubscribed, points the line of municipal improvements which should be prosecuted at this time, observes a contemporary, Concrete-Cement Age.

At the end of a cycle of good times there comes a period when the savings of the people and the prostration of ordinary business and industry bring about a period of cheap money and of unemployment for the laboring man. It is at this time in the cycle of years that those who have charge of the city, county and municipal improvements should bestir themselves to take advantage of the low money conditions and find employment for the idle workmen within their borders. All through our country new roads, new sewers, new bridges and new water plants are needed and improvements on the old are equally necessary. No time like the present has existed n many years for public work to be economically done, both with relation to the rates of wages and the rates for money, and it is hoped that the occasion will not be permitted to pass without its being availed of for the construction of these many important and necessary works.

"Because brick is the best building material is the one reason why the trade has neglected advertising it, thinking, perhaps, it would speak for itself," observes a contemporary. "It will, too, but you will have to introduce it and get the attention of the people so that brick will have a chance to make itself seen and felt. Concrete and other rivals of brick in building operations have attained prominence mainly through advertising. Proper exploitation will not only give brick more prominence, but it has the everlasting qualities that will make it stick and grow in prominence."

Factors in Painting Structural Steel

SIMPLICITY of construction is one of the chief objects to be desired, yet it may not prove possible to so design that every part can be inspected and maintained. However, if any part is inaccessible, so that it cannot be coated with paint and protected, decay or corrosion must take place and increase. All complicated details, such as depressions, horizontal pockets, cracks, crevices, etc., in which dirt and water may collect should be avoided as far as practicable. Every part should be so designed that it can be examined, repaired and painted. If necessary, special facilities, such as examination, platforms, ladders, etc., should be provided.

Engineers frequently waste money through repainting the entire structure at short intervals. As paint fails more rapidly on the sunny and the exposed sides of a structure, it would pay to clean and touch up these sore and naked places when needed, and let the healthy parts alone. Anyone who desires to be a competent judge of the workmanship of painters must himself know how to handle a paint brush, as almost any painter can fool even a shrewd amateur who is standing over him. Look well to the joints, fittings, contact surfaces and hidden parts, that water may be excluded from them. In the use of paint, much depends upon where it is used, when it is used, and the man who uses it.

Number of Coats and Their Sequence

One coating of any good oil paint will form a skin about 1/500-in. thick over a smooth non-absorbent surface such as naked steel. As all paint films are more or less permeable to moisture it is obvious that one coat is inadequate to inhibit the corrosion of a steel surface; in fact, it is too tender even to withstand the erosive effects of wind and rain. A paint skin closely resembles animal epidermis; the vital distinction between the human skin and a paint skin being that the former has the power of renewing itself, while the latter has not.

If a painted surface is seemingly dry in one day it is best to wait, to be safe, four days before re-coating it. This will insure not only satisfactory drying, but such hardening of the layer that it is in fit condition to receive another coating.

Nature of the Drying Room

The drying of oil paints may be described as a sort of breathing process; the oil must inhale or take on oxygen from somewhere, and it must inhale or give off carbon dioxide and water, else it cannot dry. A gallon of oil gradually gains about one-half pound in weight in drying, then much more slowly loses in weight until decomposed. Maximum power to resist atmospheric influences is attained at maximum weight, but no definite time can be set for this because it depends upon various factors.

Powders may be added to the oil to increase the rate of oxidation, but none of them, such as lead and manganese compounds, can make it dry fast enough. Hence the resort to japans, i.e., substantially insoluble soaps. These soaps, if well made, improve oil paints; if poorly made they lessen their value, shorten their life and burn them up.

In conclusion, the importance of proper classification of our knowledge, of selective grouping of facts and careful study of their relations in order to reach true conclusions, should be emphasized. Some of the technical features in paint making and paint using as related to the practical problems of the engineer have here been outlined. Important as these are, they will not insure the best results unless controlled by the more significant factor of confidence in the makers and users of these products upon which the life of steel structures depends.

The Effect of Smoke on Stone

IN a paper on the above subject, Dr. Benner gives a record of the soot fall in the various centres. In the suburbs of Leeds (England) he estimates this to be 26 tons per square mile per year against 529 tons per square mile per year in the industrial part of that city, whereas London has a soot-fall of 426 tons and Glasgow heads the list in Europe with no less than 820 tons. Nevertheless, Pittsburgh, in the United States, has an even worse record—ranging from 600 to 2,000 tons per square mile per year—and Dr. Benner estimates that if an equal quantity of lamp black were mixed with oil to form black paint, it would cover 57 square miles with two coats. He divides the substances derived from the combustions of fuel into two classes—(1) those which soil and make the buildings appear unsightly, such as carbon, ash tar, etc., and those (2) which are corrosive, such as sulphuric acid and others.

Dr. Bennet further says:—"In Pittsburgh we burn annually about 16 million tons of coal containing from one-half to three per cent. sulphur. A large part of the sulphur escapes into the air, where it continues to exist for the most part as sulphuric and sulphurous acids. At a low estimate we can say that at least 75 per cent. of the sulphur contained in coal escapes into the air. This, if considered as sulphuric acid, would be equal to half a million tons which, if allowed to act on limestone, would destroy half a million tons and produce 860,000 tons of gypsum.

In another paper, Mr. C. Strong, architect, discusses different methods for the restoration and preservation of stone. He says that it is only usually after injury has been done to the surface of the stone that an interest in its restoration and preservation is developed. "Meanwhile," he continues, "the pores have become so filled with adhesive tarry matters that the mode of their removal becomes quite a serious problem in itself. And this brings us to another matter. Stone, when quarried, is more or less saturated with quarry water, and this, when drawn to the surface by capillary attraction and evaported, leaves a deposit of siliceous material which forms a natural protective 'skin' on the surface.

"The successful cleaning of stone, therefore, means the removal of accumulated dirt from the pores without injury to the protective 'skin.' It is for this reason that the costly and destructive sandblast method is not to be recommended. Perhaps the best of the harmless methods that we know of at the present time is the use of ordinary soap and water applied with a scrubbing brush, or, when necessary, with the aid of a steam jet. When once cleaned, the next and final step is the application of the protective film. This is best applied when the stone is not only clean, but dry, so that the natural 'thirst' of the material will insure proper penetration and filling of the pores. As already suggested, many materials have been advocated and used for this purpose, and among these paraffin has probably played the most conspicuous part. At the present time, many secret and proprietary compounds and preparations are being offered the public for the preservation of stone. Some of these are entirely devoid of merit, because either incapable of forming a film, or because the film formed by them is soluble in water. There are, cause either incapable of forming a film, or because the however, a number of preparations made for this purpose which give promise of value, and something like a dozen of these are being tested in various ways in connection with the smoke investigation carried on by the University of Pittsburgh.

"In these cases, the samples submitted are tested on glass to show the character of the film; on muslin to show the water-proofing properties, and on limestone and sandstone to bring out non-staining, greaseless and weather-resisting characteristics. Treated samples of stone are being exposed on the roof of one of the University buildings with a view to noting the results of exposure to weather. Some preparations are also being tested on both dry and mud process bricks, with a view to noting their efficiency on these materials.

"When the results of these tests become known it will be easier to form some opinion as to the value of the preparations now offered for the protection and preservation of stone. Meanwhile, it may be said that our present experience justifies the conclusion already indicated, that the proper remedy for decayed stone is a chemical treatment capable of 'reconstituting' the decayed surface, and that the remedy for newly discoloured stone, and for the protection of new stone, is the colourless film or membrane method, applied over a clean surface for the primary purpose of excluding water."

There is no roofing material stands the ravages of smoke and the elements like good quality slate. Even in atmospheres surcharged with corrosive acids, they have been known to last a hundred years, and be as good as the day they were put on. If it will last such a length of time in such disadvantageous environments, how long would it be likely to last in a relatively pure atmosphere? What we want to arrive at, however, is not so much the remedy for the effects of smoke as some effective method for its prevention.

The Importance of Accurate Estimating in Building Construction

ESTIMATING building construction costs is very largely a mathematical process, but successful estimating often depends upon whether the estimate is made up in a mechanical or in a conscientious way. It requires, in the first place, an analytical mind. In the second place, it demands resourcefulness, while in the third place it calls for a thorough knowledge of a dollar's buying power in the labor and material markets.

It has been said that the ability to estimate is the dividing line between the journeyman and the master builder. It requires more than mere accuracy and deftness in figuring. Experience and judgment are absolutely essential, a working knowledge of building construction, various materials, their market values, and the discounts allowed in the trade is vital. Then he must know how to apply them to the peculiar conditions which surround the operation he is working on. But prices and discounts are constantly changing, and cost of labor is higher to-day than at any time in the history of construction and even construction methods are not proof against revision and reform. Building laws must conform to this progression, and what was lawful last year, may, by ordinance, be entirely unlawful this year. These are only a few of many departments with which the estimator must keep abreast, because each change in practice or improvement in material or methods, has a tremendous bearing upon the ultimate price of the operation and frequently, in this age of speculation, upon the final decision of the owner as to whether he will go ahead with his plans or postpone.

In Touch With Market Conditions

It, therefore is apparent that the estimator must keep in constant touch with market conditions. To do this he must depend largely upon his own queries for figures and discounts, but the only way in which he can know that he is getting all the discounts he is entitled to is by consulting market reports and by noting the trend of buying or selling in the wholesale market and the conditions governing the sources of supply and shipment. Despite anti-trust and anti-monopolistic laws, the tendency of the times is to standardize building materials of all kinds and as soon as these are standardized, prices naturally will be on a more or less fixed, or staple level. The price for many building materials to-day seldom, if ever, change, but the discounts on them fluctuate widely and sometimes suddenly. Glass and hardware are notable examples of this kind of price changing. Other materials, such as lumber, cement, common brick, sand, steel, gravel, crushed stone and cinders are subject to the primary law of supply and demand and their prices are liable to change without warning. There are other materials, such as front brick, stone, marble and roofing material which seldom report a fluctuation, and there are still other materials, like architectural terra cotta, upon which there is no fixed price, a special figure being given by the manufacturers according to the intricacy of the design.

Because of this wide variation in prices some estimators figure their whole proposition out on a time basis, estimating materials in quantities and keep a cost data system in their offices upon which they can rely when information of this sort is sought at some future time. This is done whether the bids were successful or not. They afford an opportunity to compare the estimates of cost of the different items, with the actual cost of execution; and if a bid fails to win the job, satisfaction and experience may be gained by noting the items which may have been priced too high or too low. Another source of information is the catalogue. If these are properly indexed, for ready reference, they will be found of great value for specific information. For close estimating, bottom prices and full discounts are necessary so that the estimator here consults the prices quoted by the salesmen direct, guided, the while, by the current market reports in his specialty publication carrying this kind of service.

The Lump Sum Plan

It is the practice among small contractors to add a lump sum to the total costs, the size of which depends entirely upon the activity of competition and the circumstances of the operator. If the payments are to be arranged on advantageous installments, so that the bidder can take advantage of the time discounts allowed on all work, he makes his profit a little lower. If long payments (hence heavy interest charges), are specified, then his profit appropriation is apt to be big. Some estimators base their profits upon a percentage of the estimated cost. This varies, in ordinary cases, from ten to twenty per cent., according to the calibre of workmanship stipulated and the selection of material and the expense of handling it. Therefore, locality counts for much in the high or low cost of the work.

Figuring on duplication is an important item especially if the work is of the suburban residential type, where one building will be duplicated many times. A considerable saving is then possible, because certain kinds of material are purchasable in large quantities, either worked or unworked. This is especially true in manufactured parts, such as doors, windows, columns, ballustrades, trim and flooring. The distance of the work from the material distribution centre has much to do with the profit although when materials can be taken direct from the car to job on a special order, the cost is materially reduced, because then the material has only one handling and the extent of damage or waste is greatly reduced. Many contractors keep on file data of haulage costs from different sites on which they have figured for reference and in this way they sometimes are able to underbid their competitors on this item alone. The most convenient and reliable of these systems is known as "cubing." It is a system of taking the cubical contents of a building and fixing a price upon it. The rate is obtained by a comparison of plans and requirements with similar buildings which have been erected under conditions as near like those of the job in hand as it is possible to find them.

Determining Cubical Costs

There are several methods of determining cubical costs, however. One method is to multiply the square feet in the plan of the building by the height from half the depth of the foundation to half the distance to the roof. Another system uses the height from the bottom of the foundation and another obtains the actual cubical contents. Any of these may be used if the data for comparison is obtained in the same way, but all are subject to important variations which experience and judgment alone will determine. For instance, if the contour of the building is very uneven, with low portions, such as porches and sheds and high portions, such as towers and cupolas, these must either be omitted from the whole and compare separately or a lump sum be added or subtracted according to the size and elevation of these members.

Another variation arises in the sizes of the rooms, giving a ratio of partitions and division walls which is not constant, and of course, a large building with many duplicate parts will require a different rating from a small one, so that the method of estimating by cubing is at best approximate, and its degres of accuracy depends largely upon the experience and judgment of the contractor. Even long experience will afford no safeguard against unusual feature of the interior, so that the cube rates can only be applied to buildings of ordinary character, and comparisons are only reliable between buildings of like descriptions and uses, as the treatment of even the same materials will vary largely in buildings of varying uses. The height of a building will not increase the cube rate proportionately, unless the internal voids are alike, although it is certain that the higher one builds from the ground the more time and expense it requires to put the material in place, to say nothing of thicker walls or heavier steel and more expensive equipment, especially in elevators.

Estimating by Square Feet

A convenient method of estimating is by the square of 100 surface feet. This is especially applicable to office buildings, schools, mills, stables, garages and all buildings where the floors are few in number or similar in plan. For one-storey buildings the price per square is taken to include the roof walls, floor, and foundations, but for buildings of two or more storeys the price per square should be taken separately for each floor, the lower floors being prices to include the foundations and the top to include the roof.

This method of estimating by the square is not so accurate as by cubical contents, but the results are often more convenient and adaptable, because the tabulation of the square area of the various floors may be easily reduced to terms of accommodation for public buildings or shops. For instance, a given floor area in a school house means accommodation for a certain number of pupils; in a church for a certain number of sittings; in factories for the manufacture of, staple goods, a certain number of machines and operatives. This unit of accommodation is sometimes carried farther and, by the reverse process, is made the basis of another method of estimating the approximate cost of such buildings, i.e., schools, churches, factories, hospitals, mills, etc. This also is used as a method of comparison, the known data being supplied by previous experience or by calculation. and it is often valuable as a means of determining the approximate cost of buildings necessary to accommodate a certain number of individuals or machines, even before any definite plans have been drawn.

All of these methods are approximate, with varying degrees of accuracy. But before using this system as a basis for a contract figure, a sum, governed by the judgment of the estimator of the actual operation, should be added to the total of the original estimate to allow for any possible shortage.

* * *

For making holes in thin glass, put a piece of stiff clay or putty on the part you wish to make a hole. Make a hole in the clay or putty equal to the diameter of the hole you wish to make in the glass. Into this hole pour a drop of molten lead and the piece the size of the hole will drop out.

* * *

A good fireproof cement can be formed of iron filings 140 parts, hydraulic lime 20 parts, quartz sand 25 parts, salammoniac 5 parts, and enough of vinegar to make a paste. A similar cement consists of iron filings 180 parts, lime 45 parts, and common salt 5 parts, converted into a paste with strong vinegar.

* * *

The Royal Institute of British Architects has compiled a record of the members of the architectural profession who have joined various branches of the Imperial Forces. The list, which includes members of the Royal Institute of British Architects and its nineteen allied provincial societies of the Architectural Association and of the Society of Architects, and students of the various schools of architecture recognized by the Royal Institute, now contains more than 1,200 names, and the number is being increased every day.

The Elements of Knots and Hitches

By Edward Van Kaenel

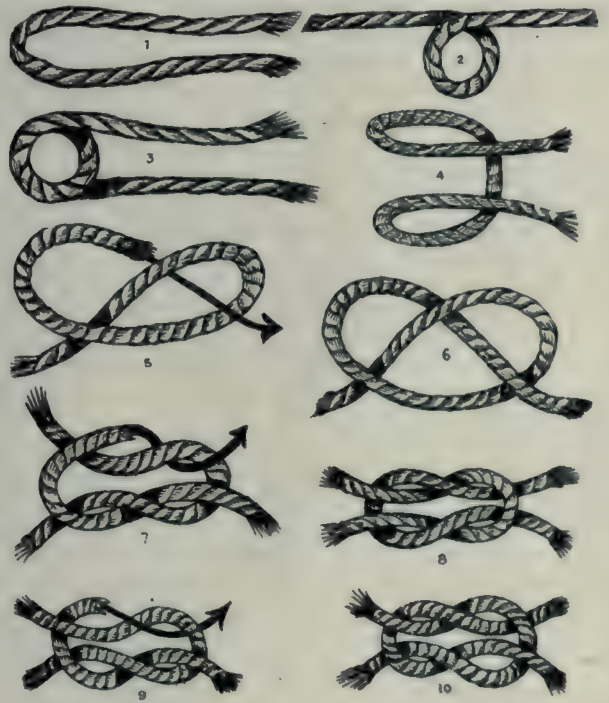
WHEN one's safety depends on the tying of a knot it is important that the knot be tied properly. The strength of the line is important only as the knot holds.

However tight a knot holds, however, it should be possible to easily untie it when necessary. A man handy with lines realizes this and as a consequence uses some of the many forms which have become well known through long use by sailors, riggers and others.

Figs. 1, 2, 3 and 4 show the simplest forms of turns, bights, loops and double loops, preparatory to tying the knots shown in the other figures.

Figs. 5 and 6 area the Overhand Knot, which is often used on the ends of ropes when one is in a hurry, also in tying a timber hitch. Its use insures safety.

Figs. 7 and 8 show the Square Knot, the commonest knot made, and possibly the one most abused. It is used for tying two ends together, and should always be tied as shown. A novice often tries to tie this knot, but makes the "Granny Knot" or "Lubber's Knot," shown in Figs. 9 and 10. Get the distinction between these two knots firmly in mind, for the Square Knot is secure and easily untied, while the Granny Knot is insecure, apt to slip, jam or wedge, and difficult to untie after a load is put on it. A good way to learn this knot is with the ends of a short piece of sash cord, and it should be practised until the Square Knot will almost tie itself in the dark.



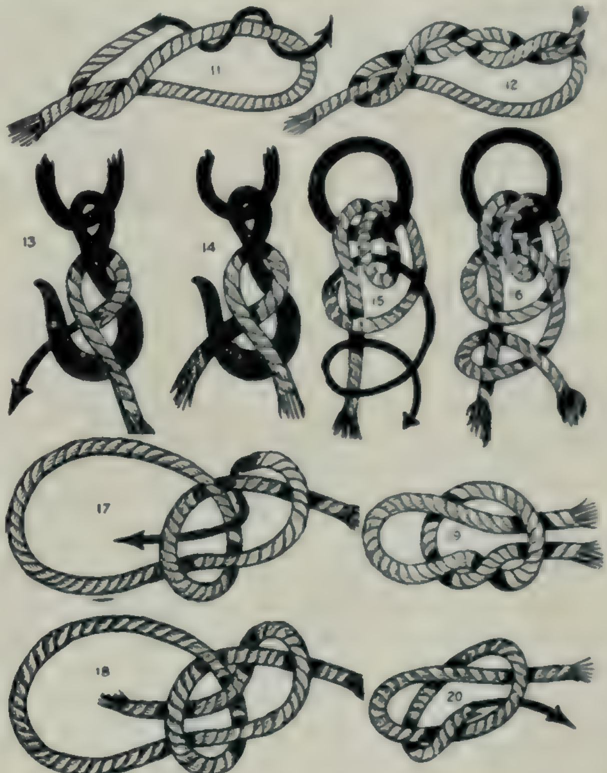
Figs. 1-10.

Figs. 11 and 12 show the Timber Hitch, which is used in hoisting boards, logs, poles, etc. Several turns should be made as indicated and the knot pulled tight before lifting the load. An Overhand Knot, Fig. 6, on the short end is an additional safeguard with this knot.

Figs. 13 and 14 are known as the Blackwall Knot and depend for their holding on cramping the inner turn against the hook. It is easily reversed, yet holds firmly. In a reversed position it is sometimes used on the lower block of a tackle to hold the load at any desired point.

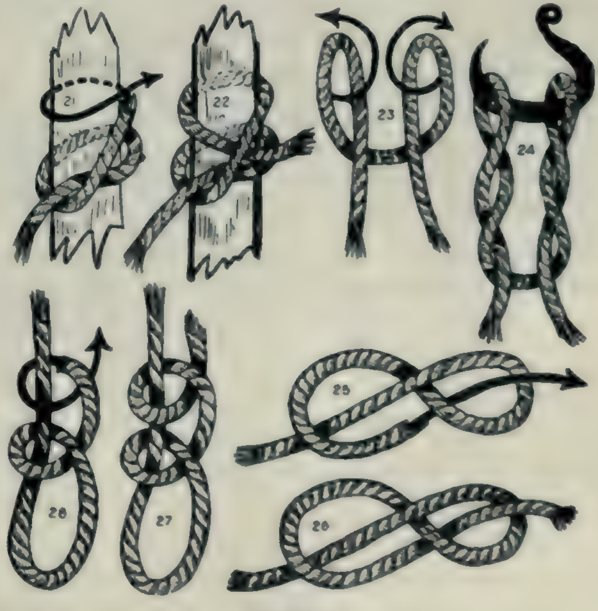
Figs. 15 and 16 describe a knot used on block and tackles, rings, etc. It is known as the Anchor Bend and is secure even when the load is loose. When properly tied it will not work loose.

Figs. 17 and 18 show the Bowline Knot, one of the handiest knots in the list. It holds without slipping, does not jam when used, and unties easily. When used for a loop it does not slip up, but it must be carefully tied. Practice on this knot is well worth the effort.



Figs. 11-20.

Figs. 19 and 20 are of a Slip Knot. It is readily formed from a loop as shown and is handy for such loads as bags of cement. It can be tied in the middle of a line.



Figs. 21-26.

Figs. 21 and 22 are Clove Hitches, and are used for making a guy line fast. It is another good knot to practise on.

Figs. 23 and 24 are the Cat's Paw used for guying and for preventing the twisting of the block and tackle system. A load may be safely suspended on either end of the line.

Figs. 25 and 26 are more an ornamental than useful knot, but it can be used on a single rope ladder by making the knots a foot apart. It is useful also as a stop knot for main lines, as it will not go through a block.

Figs. 27 and 28 show a quick method of tying up bundles of objects such as lumber, bricks, stone, slate, etc. It is probably more secure than the Timber Hitch (Figs. 11 and 12) and is used for about the same purpose.—National Builder.

The Engineer and The Contractor

CONTRACTS and Specifications formed the topic of discussion at a recent meeting of the Vancouver branch of the Society of Civil Engineers, when the relationship between the engineer and the contractor and other interesting matters were also taken up. Mr. G. R. G. Conway, President of the Branch, occupied the chair.

The discussion was opened by Mr. Robertson, of the McAlpine, Robertson Construction Company, who spoke as follows:

Our discussion on the relations of the engineer and contractor naturally resolves itself into a consideration of the conditions governing their business dealings, these conditions being laid down in the various documents which together form a contract to execute work.

The disputes and litigations which occur unfortunately so often show that there is much room for improvement in the conditions governing contracts, and it is hoped that a frank discussion of the matter may help towards the desired end of having engineers and contractors to see eye to eye.

A committee of our Society has had under consideration for a year the question of General Clauses of Specifications with a view to forming the groundwork for a standard form of contract. The committee's recommendations were submitted to the secretary of the Society and discussed at the general meeting in Montreal in January, and the matter has been referred back to the committee for further consideration.

A discussion of all the points in contracts and specifications which are apt to cause trouble and litigation would furnish occupation for many meetings, and you will understand that the few points which I raise in opening this discussion do not by any means set a limit to our proceedings, as doubtless all of you have in mind certain points which your own experience has shown to be fruitful of trouble.

A specification with the plans should furnish a complete and clear description of the work to be done, and the general conditions and terms of the contract should state the conditions under which the work will be carried out, and at this time of day it should surely be possible for engineers to draw up a contract which will convey clearly these conditions to the contractor and to eliminate a great many clauses which are not only unnecessary but actually contradictory. In many contracts there are clauses which seem to be a survival of traditions, and which are probably included because the contract is copied from some old form and a few more clauses added to it to meet local conditions, without proper consideration being given to the effect these added clauses may have on the original contract. I will give you an extraordinary instance of a survival of traditions:

Mention Fire Insurance, Torpedo Base.

I shall now mention a few of the points in contracts and specifications which are fruitful of trouble and misunderstanding, and again remind you that our discussion is not limited to the points I raise.

Classification of Excavated Materials

This has probably been the subject of more disputes than any other single point in contracts. The more items of classification there are, naturally the more likelihood there is of differences arising, and the ideal classification so far as avoiding trouble is concerned would be to have two classifications—solid rock, and all other materials. I am, however, opposed very strongly to the idea of making the contractor guess at information which the engineer himself might supply, and I should like to see far more money spent in trial pits and borings—trial pits especially. On very many jobs, especially sewer work, and on many cuts in railroad work, the initial expense of putting down trial pits all over the work would be trifling compared to the cost of the work, and would be saved many times over in the long run. I shall refer later to the importance of the personality of the engineer, but will say now that this question of classification is one which should not be treated in a cheese-paring way, and that in cases of doubt full consideration should be given to the cost of operation, assuming efficient and proper methods to have been adopted by the contractor. It is quite a fair statement to make that if, on the completion of the excavation of a railway, the work were to be classified and valued at schedule rates by half-a-dozen engineers of recognized experience and ability, each one making his inspection alone and on a different day, and each making his classification without consulting any of the others, the difference between the highest and the lowest would certainly be twenty per cent.—which is of course the difference between a fair profit and a serious loss. Reasonable compromise and fair give-and-take should settle most of the classification disputes, and in cases of real hardship on the contractor the cost should be considered.

Schedules

In the discussion following Mr. Creer's paper on Burrard Peninsula sewers reference was made to the very complete information supplied to the contractors tendering on these sewers, especially the very full details of quantities given in the schedules. I want to emphasize my view that engineers and architects ought to supply schedules of quantities for all work, The time and money wasted by contractors in taking off quantities, especially in building jobs, is appalling. Competition in pricing is keen enough without adding a competition in quantity surveying, with the additional evil that it is very often the careless and incompetent quantity estimator who gets the work. I should like to see here the same system (on building contracts especially) as that adopted in Britain, where schedules are prepared by qualified quantity surveyors. I believe I am right in saying that in England the contractor has a ground of action against the surveyor if his bill of quantities is wrong. I do not object to a lump-sum contract, but I consider that the basis for arriving at the lump sum should be the same for all bidders. When I speak of quantity surveyors I refer to them in connection with building contracts, as of course in what we might call Public Works contracts the engineer is fully qualified to prepare a bill of quantities.

Prime Cost Sums

While we are speaking of schedules there is one class of item that I should like to see included much oftener, and that is the item of prime cost sums. In many cases, especially in building contracts, specific articles of equipment are mentioned of which there may be many grades on the market, and the contractor is often at a loss to know what particular grade is required. In such a case an item stating a definite sum to be included puts all bidders on the same footing. Another instance of a somewhat similar nature is that where stone from a particular quarry is specified to be used for building purposes. It happens sometimes that the owner of a quarry is a contractor who is bidding on the work, and such a condition of affairs is apt to operate in favor of the contractor who owns the quarry. In such a case I think that it would be an improvement on a prime cost item if the engineer or architect were to say that the stone will be provided by the owner.

Arbitration

A generally approved practice provides for what is usually called a three-man arbitration on disputes other than these regarding quality of material and class of workmanship. Quite a number of contracts, however, nominate the engineer as arbitrator, and state that there can be no appeal from his decision. This, to my mind, is manifestly unfair, and especially so in this country, where so much work is carried out by corporations and companies employing their own engineer. The evil is very much lessened where the owners employ an outside firm of engineers as their representative—for my experience has been that engineers in private practice, as a body, really do their best to adjudicate fairly in cases in dispute. Consider, however, the case of a small municipality, employing (as small municipalities usually do) a young engineer. I submit that in such a case, as in many others, human nature has to be considered, and the engineer knows that if his decision favors the contractor he will probably be severely criticised by his Council, the members of which usually know very little about the real merits of the case. This is especially the case if any of the trouble appears to arise from causes which may be laid at the door of the engineer, and I submit that such a state of affairs is not conducive to the scales of justice being held evenly.

Discrimination in Letting Work

When tenders are called for any work the advertisement usually states that the lowest or any tender will not necessarily be accepted. In practice this clause is taken advantage of when all the bids are considered too high, but it is very seldom considered when the bids are too low. In other words, the owner protects himself against what he may think a high price, but should the price be too low that is a matter for the contractor and the bonding company. Now, the contracting business here is and has been for some time in a very bad way. Apart from the actual scarcity of work, I am certain that three out of four jobs let now are let below cost. The list of contractors who have fallen by the way is appalling, as the banks and supply houses will tell you, and in my opinion this is due nearly always to the work having been taken at too low a price—very often by unknown men who have nothing to lose, and who, in the slang of the country, are operating on a shoe-string.

As business conditions settle down in the West I hope to see the engineers grading contractors according to their records. To be a good contractor does not mean that a man must be a big contractor. There are jobs for all grades, the usual rough line of division being that of financial ability to carry out works of a certain size. I am more familiar with British practice in this respect, and it is quite the usual thing for an engineer to keep lists of reliable contractors, graded according to the size of job they can handle. The small men are not asked to tender on big jobs, nor are the big men asked to bid on small jobs. I should like to see engineers here in a position strong enough to enable them to say, when a tender which is obviously too low is submitted by a man or firm of consistently bad reputation, that his bid should not be considered. Unfortunately, in the rather peculiar state of business morality here, such action by an engineer would almost certainly lead to his being accused of wanting the work to go to some favorite of his own.

When I came to Vancouver five years ago I called on an engineer who was then handling a large amount of work, and presented my credentials. He told me it was a matter of indifference to him whether a bidder on his work was a contractor or not—that if the lowest man could put up a bond he would always get the work. I should have great hesitation in taking a contract from that engineer. And this brings me to what is probably the most important factor in the relations of the engineer and the contractor. I refer to the personality of the engineer. It is quite a common saying among contractors that if every clause in a contract were carried out to the letter every contractor would be put out of business. Some engineers have a notoriously bad name, and do not seem to appreciate the responsibilities of the honorable positions they occupy. If the contract is used merely as a legal document, and constantly held over the contractor as a club, and harassing and vexatious conditions insisted on unnecessarily, trouble is sure to follow. The wise engineer knows that many contract conditions can be ignored without any harm being done, and that many facilities can be given to a contractor to help on the work; and if contractors as a body do not take an unfair advantage of these concessions, but in their turn are prepared to go out of their way, even at an extra expense, to meet some special request of the engineer, and play the game of give-and-take in a reasonable way without expecting extra pay for every trifling piece of extra work, I feel sure that the relations of the engineer and the contractor will improve to such an extent as to eliminate a great many of the disputes which at present are but too frequent.

Prevention of Dry Rot in Mill Buildings

PREVENTIVE measures recommended in the case of dry rot in mill buildings are discussed by Mr. F. J. Hoxie, engineer and special inspector for the Associated Factory Mutual Fire Insurance Companies, in an informative booklet entitled "Dry Rot in Timber," from which the following extract is taken:

Ventilation and Painting

Ventilation is generally the first preventive measure suggested. Dry wood which is placed in an atmosphere well below the moisture requirements of a given fungus is undoubtedly incapable of infection with that fungus, but ventilation does not necessarily cause drying, as the wood will come into equilibrium with the moisture in the air and will become dryer or wetter in proportion to the relative humidity of the air with which it is ventilated. Therefore, timber ventilated with moist air may have its rate of rotting accelerated rather than retarded. As an example, a thoroughly waterproof covering for a column which had been completely dried would be more useful than a hole through the centre for ventilation if this column were used in a moist paper mill.

A heavy coat of paint may accelerate or retard the rate of rotting, depending upon whether it prevents the wood from absorbing or giving up moisture. The condition most commonly met in which paint causes rotting is when it is applied to green timber saturated with water. With sound timbers which are to be placed in a moist atmosphere, a paint will doubtless prove beneficial in proportion to its waterproofing power. "Cold water paint" or "fireproofing" paint containing hygroscopic materials would be expected to accelerate the progress of dry rot, because it attracts moisture from the air and increases the moisture in the wood.

Life of Fungi

Dry-rot fungi grow by two methods of reproduction. The common reproductive spore grows over the surface of the plant, but under unfavorable conditions, such as insufficient moisture, the plant separates into small sections which can sprout and grow again when conditions are favorable, and can remain from two to four years in the resting state.

Dry rot is chiefly spread by direct contact, but possibly living spores carried in the air can take root when they find a favorable resting place. Fungi are frequently carried in lumber and spread to other susceptible material by placing it in large piles with scant ventilation. As a result of this, beams are often found more deeply infected in the middle than at the ends.

Prevention by Heating and Drying

Often an infected building can be sterilized by skilful use of its own heating system. Dry-rot fungus is particularly sensitive to heat, a temperature of 108 deg. Fahr. for three hours or 115 deg. for one hour being sufficient to kill it. It is also killed by complete dryness, but ordinary air drying does not destroy it. A badly infected mill was treated four times over the week-end by using its own steam-heating plant and raising the temperature to 115 deg. Fahr., but later it was found that the disease had already progressed so far that the beams had to be replaced. To test the effectiveness of the treatment, specimens were taken from forty badly rotted beams and only four showed living fungi, while, on the other hand, beams removed from the mill before it was heat-treated showed a vigorous growth of fungus on cultivation, and also the formation of normal fruiting plants when left lying in the yard.

While these experiments are not absolutely conclusive, they are very encouraging and indicate that the small cost of putting steam on the heat coils is well worth trying, if there be any suspicion of dry rot in a new building. Heating will probably prove more efficient in the few scattered superficial inspections of a mill just completed than it did in this mill, where the growth had been in active progress for two years or more and had deeply penetrated the susceptible material.

Holes in Columns and Double Beams

Sometimes holes are bored in columns and beams for the object of preventing dry rot, but the common custom of boring green or wet columns just before they are put in place in a building and using moist lumber for double beams **leaves ideal places for the growth of fungus,** as the air in the openings may be nearly saturated with moisture. The holes in the columns have the additional objection of forming a convenient passageway for the fungus to pass rapidly from floor to floor before the building has dried out.

In slow-burning timber construction it has been customary in many cases where an unusually stiff floor is required to use 2 x 4-in. or 3 x 6-in. planks spiked together on edge for forming the floor. This so-called laminated construction is very treacherous so far as rotting is concerned, particularly if the planks of the lower floors before the walls of the upper storeys are complete, thus leaving them exposed to the weather until the roof is put on. Sometimes the floors become thoroughly water-soaked by means of the numerous cracks between the planks on edge and by the top flooring. This moisture encourages rot. In storehouses for which this form of floor is frequently used, the conditions are worse than in the manufacturing rooms because the storehouses are seldom artificially warmed in winter, thereby giving less opportunity for drying. Several such cases have been reported within a few months.

Engine Houses: Principles of Design

THE careful study which the American Railway Engineering Association has given to engine house designing in recent years has resulted in definite conclusions, which are embodied in the following report of the Committee on Buildings:

Form

(a) The circular form is preferable.

(b) At points where not more than three or four locomotives are housed at one time, and where it is more economical to provide a "Y" track than a turntable, or where it is not necessary to turn locomotives, a rectangular house, either with through tracks, or with switches at one end only, may be desirable.

(c) At shops where a transfer table is used, a rectangular engine house served by the transfer table may be desirable.

Turntable

(a) The turntable should be long enough to balance the engine when the tender is empty.

(b) A deck turntable is preferable to a through table.

(c) At important terminals, turntables are most economically operated by mechanical means. Where few and light engines are turned, hand operation may be desirable.

Where electric power can be obtained at a reasonable cost, an electric tractor is the most efficient means for operating a turntable, the cost of power is cheaper, and it is superior in continuity of service and maintenance. The first cost is approximately the same as an air motor of equal power and size.

Power wires are brought to table by either the overhead or the underground method. Overhead device has the advantage of accessibility for inspection and repair. Special care must be taken to properly protect the collector head from weather and gases and support collector rigidly (framework supporting same should be fastened to a steel frame of table and not to ties, and must be securely braced); the wires should be large enough to keep them from breaking from sleet and should be supported to framework supporting collector. Any play at table mutiplies at collector head. Wires should be brought to pole, close to curb of turntable, keeping lines as far distant from nearest wall of roundhouse as possible, to minimize the danger of destruction by fire.

When the underground system is properly installed, its advantages are that all exposed non-current carrying parts are permanently grounded, including the circular-track rail (the only part of system to repair is collector head); non-interference from weather if turntable pit is properly drained.

The disadvantages are: The wire is not so easily repaired, and is much more difficult to originally install, as it must be properly protected from water, and cannot be successfully laid in a fill or on ground where settlement or shifting takes place. Where turntable pit cannot be well drained, it cannot be used with success. It has the advantage of protecting power to run table in case of fire to roundhouse, especially in one of a nearly complete circle.

Compressed air tractors are frequently used.

Ordinarily the power costs much more than electricity and is not so reliable. At points having no power plant the locomotive to be turned furnishes the compressed air; in this case an auxiliary supply should be maintained by providing small air tank secured to the turntable for operating it before or after the engine is placed.

(d) The deck on turntable should be wide enough to provide a walk on each side and be protected with hand rails.

Turntable Pit

(a) The turntable pit should be well drained and preferably paved.

(b) The circle wall should be of concrete or brick, with a wood coping not less than 6 inches thick.

(c) The circle rail should preferably bear directly on concrete base. The use of wood ties and tie plates supported by masonry is desirable under some conditions.

(d) Easy access to the interior of a turntable for the oiling of bearings, painting and inspection should be provided in the design of the turntable pit, unless ample provision is made in the turntable itself.

Door Openings

The clear opening of entrance doors should not be less than 13 ft. in width and 16 ft. in height.

Doors

Doors should be easily operated, fit snugly, be easily repaired and maintained, and should admit of the use of small doors.

Tracks

(a) Lead tracks to the turntable should line up with tracks of the engine house where possible.

(b) Tracks should be on a level grade and should be provided with stop blocks.

(c) Special fastenings of the track rails at the circle wall and on the turntable are desirable to prevent movement of the rails, to give good bearing, and to lessen the damage from derailed wheels.

Position of Locomotive

In a circular house the locomotive should stand normally with the tender toward the turntable.

Length of House

The length of stall along centre line of track should be at least 15 ft. greater than the over-all length of the locomotive, to provide a walk-way behind the tender, a trucking space in front of the pilot and a certain distance in which to stop the locomotive or to move it to bring side rods or other parts into convenient positions.

Materials

(a) The material used in construction of the house should be non-corrosive, unless proper care be taken to prevent corrosion.

(b) The additional security against interruption to traffic from fire warrants serious consideration of the use of a fireproof roof, and dividing the engine house into units of approximately ten stalls by the use of division walls built of fireproof material.

(c) When the roof is of reinforced concrete the columns and roofbeams should be of the same material.

(d) Reinforced concrete should be used for the walls only where special conditions reduce its cost below that of brick or plain concrete, and should not be used for that portion of the wall directly in line of track where engine is liable to run into it.

Engine Pits

Engine pits should be not less than 60 ft. in length, with convex floor, with drainage toward the turntable. The walls and floors may be of concrete. Proper provision should be made for the support of the jacking timbers.

Smoke Jacks

The smoke jacks should be fixed. The bottom opening should not be less than 42 ins. wide and long enough to receive the smoke from the stack at its limiting positions, due to the adjustment of the driving wheels to bring the side rods in proper position for repairs. The bottom of the jack should be as low as the engines will allow, and it should be furnished with a drip trough. The slope upward should be gradual to the flue. The area of the cross-section of the flue should not be less than 7 sq. ft., and the jack should be made of non-combustible material. (This design of jack applies to all houses where regulations will permit. In some cities, where smoke abatement laws are in force, special design of jacks are necessary.)

Floors

The floor should be of permanent construction. It should be crowned between pits.

Drop Pits

Drop pits should be provided for handling truck, driving and trailer wheels.

Heating

(a) Heat should be concentrated at the pits. The outlets should be fitted with dampers, so that heat can be cut off while men are working in the pit.

(b) The general temperature of the engine house should be kept between 50 deg. and 60 deg.

(c) The recommended method for heating is by hot air driven by fans through permanent ducts, which should be under the floor, where practicable. The fresh air supply should be taken from the exterior of the building and no recirculation allowed. It should be delivered to the pits under the engine portion of the locomotive. It should be heated as far as possible by exhaust steam, supplemented, as required, by live steam.

Window Lights

(a) The disadvantages of skylights are so much greater than their advantages as to make them undesirable.

(b) Windows in the outer walls should be made as large as practicable with the largest glass or light area consistent with the requisite strength. In general, the lower sill should be not more than 4 ft. from the floor, and only sufficient space left between pilasters and sides of window frames and girders and window heads to properly secure the window frames. Windows or transoms as large as practicable should be provided over all doors where locomotives enter. Window lights in doors are objectionable on account of difficulty of maintenance.

Electric Lighting

General distribution of illumination should be provided between pits by arranging a number of lights to avoid shadows and to give good light for workmen at the sides of the locomotives. There should be plugged outlets for incandescent lamps in each alternate space between pits.

Piping

(a) The engine house should be equipped with piping for air, steam and water supply, and where desired, piping for a washout and refilling system should be installed. Where this system is installed, the blowoff lines should be led to a central reservoir; where it is not used, the blowoff lines should be led outside the house.

(b) The steam outlet should be located near the front end of the boiler. The blowoff pipe, the air, the washout and refilling water and the cold-water connections should be near the front end of the firebox. Connections need only be provided in alternate space between stalls.

Tools

There should ordinarily be facilities provided for hand tools and for the location of a few machine tools, preferably electrically driven.

Hoists

Hoists with differential blocks are generally used for handling heavy repair parts, and suitable provision should be provided for supporting them.

Comparative Costs of Brick and Concrete Roads in Illinois*

By H. E. Bilger†

FROM the actual cost records of constructing about 75 different sections of state highway in Illinois during the last year it is certain that the itemized estimates were reasonably well balanced. By excluding all rough grading, drainage structures and the like, and prorating the estimated cost of the pavement proper to the contractor's bid, it is possible to get not only relative figures, but almost absolute prices on the different concrete and brick pavements proper.

From the experience gained on these 75 contracts, it would appear that where the haul does not exceed 2 mi. the brick pavement proper has been built at an average cost to the taxpayers of $2 per sq. yd. and the concrete pavement proper at a cost of $1.20 per sq. yd. The greatest variation from these average figures is not large, and they may be taken as substantially correct, save that with slight changes in the specifications the price of the brick pavement proper, including the concrete curb, could have been reduced to $1.90. Having those two figures in mind, $1.90 for brick and $1.20 for concrete, it is interesting to consider some of the economic features of these two types of pavement.

If we assume for road improvement the issuance of 5 per cent. 20-year serial bonds, payable annually, the interest charges on the value of 1 sq. yd. of brick pavement would be $1.

Reliable data on the maintenance and repair expenses for brick roads in rural territory are not available. From what are available, however, and from the experience of small cities with this type of pavement, it would appear that a charge of 1c. per sq. yd. per year would be sufficient to cover all maintenance and repair on a brick road in rural territory for the first 25 years.

These three costs—namely, first cost, interest and maintenance—total $3.15 per sq. yd. as the actual cost to the taxpayers of a brick road at the end of 25 years. Maintenance charges on the shoulders and right-of-way are excluded from this consideration, inasmuch as they apply equally to whatever type of pavement is adopted.

The corresponding interest charges on the cost of 1 sq. yd. of concrete pavement would amount to 63c. Cost data on the maintenance and repair of concrete roads are even more meagre than on brick, and estimates as to the probable life of the road are still more at variance. One would be presumptuous, indeed, to assume that under mixed traffic conditions the probable life of a concrete road would be as long as that of a brick road. However, from the experienec with the concrete roads that have been constructed in recent years under the supervision of the Illinois State Highway Department, and from my own personal observations elsewhere, there is every indication that the concrete road is amply capable of rendering a service fully commensurate with its cost of construction.

It is quite probable that after a service of nearly 15 years under mixed traffic, the road would economically admit of resurfacing. From present knowledge it would appear that the most practicable low-first-cost resurfacing for a concrete road, unevenly worn, is one of bituminous concrete some 3 ins. in average thickness. It is quite likely that this surfacing would incur an expenditure of as much as 75c. per sq. yd. To meet this expense, if we issue 5-year serial bonds, payable annually, computing interest as before, and estimating maintenance charges at 2c. per sq. yd. per year throughout the 25 years, we have a total cost of a concrete, bituminous-top road at the end of 25 years of $3.19 per sq. yd.

It is hardly probable that the maintenance and repair charges under the conditions in question could fall below 2c. per sq. yd.; but it goes without saying that there are elements of uncertainty in the foregoing consideration of upkeep in both types of pavement, as well as in probable life. Moreover, the other estimates of cost will be somewhat modified by local conditions.

Omitting topographic requirements it can be stated generally that the considerations in order of weight for the adoption of these types of pavement are, first, intrinsic merit; second, a final cost to the taxpayers.

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*From a paper read before the Illinois Society of Engineers and Surveyors.

†Road Engineer, Illinois State Highway Department, Springfield, Ill.

The Channel Project

MR. Arthur Fell, M.P., Chairman of the British House of Commons Channel Tunnel Committee, in view of the many inquiries received as to the present position of the English Channel tunnel project, has issued a statement in which the view is expressed that although the war has delayed the commencement of the tunnel, it has rendered the actual building of it much more certain. "It is too soon," the statement goes on, "to discuss the effect it would have had on this war. Whether the German advance on Paris would have been on the whole or partly diverted against Calais and the French defences at the mouth of the tunnel—whether the tunnel would have been captured and its flooding and interruption by us rendered necessary—how much permanent damage would have been done to it—these are all most interesting subjects, but they cannot be usefully discussed now. We can only take the results of the war as we have found them, and Calais and the French end of the tunnel and the railway from Calais to Paris, although threatened, have remained in the hands of the Allies. The tunnel could, therefore, have been used for the transport of our Expeditionary Army and stores, which it could have carried with safety, and the delay and expense of transhipment for the Channel voyage would have been avoided. How many millions of pounds this would have saved us we cannot yet calculate. We hope that after the termination of the war the matter will be pressed forward without delay, and this will be, it is hoped, one of the first great works begun when peace is made."

From Montreal comes an interesting account of a case heard last week before the Court of Review. Briefly, Napoleon Rousseau, a contractor, had undertaken the erection of a house for one Joseph Raymond. The work was completed and the house accepted by Raymond, who, however, refused to pay because there had been a delay in the work and because certain details had not been properly completed. The evidence disclosed the fact that the contractor had deemed it advisable to let some little time elapse before building on the foundations, which had shifted somewhat on account of the frost. In regard to the non-completion of the work, it was shown that the defendant had done work amounting only to some $5 or $10. In giving judgment in favor of the plaintiff the Judge remarked that the purpose of the law was not to quibble over trifles, and that in building contracts there might often arise small details the inclusion of which in the contract would be doubtful.

Great Britain and the War

An Inspiring Address by Dr. Cody before The Engineers' Club of Toronto.

THE chain of circumstance and event which led up to the War, the part played in the great European conflict by the belligerent nations, and the collapse of the elaborate plans laid by the German General Staff, were reviewed by The Venerable Archdeacon Cody, Rector of St. Paul's Church, Toronto, in an inspiring address delivered before The Engineers' Club of Toronto on the evening of Friday, April 9th.

Dr. Cody took for his "text" the now well-known words of Kipling—

> "Who stands if Freedom fall?
> Who dies if England live?"

The outstanding feature of the address was the emphasis laid upon the right of Britain's cause, and the responsibility of the various parts of the Empire in striving with the Mother Country for the preservation of freedom and democracy in the world and for a general recognition of the sacredness of treaty rights.

The speaker dwelt on the stupendous character of the War. It was a war of ideals—of democracy versus autocracy—of freedom versus tyranny. The events of the last few months had revealed many things which had surprised and shocked Great Britain. In the first place, there was Germany's world-wide system of espionage; in the second, there was the utter breakdown of German "Kultur" in actual warfare. Another element of surprise had been the vast strength of the German war machine; and still another, the revelation of a wide-spread and deep-seated hatred of England, revealed for example in Lissauer's infamous "Chant of Hate." The atrocities committed by the German soldiery were the natural result of the principles laid down in the German War Book issued by the German General Staff. The governing tenet of this publication is that the end justifies any means, and that anything is legitimate that ensures success. Fear of reprisals is the only limiting consideration.

Speaking of the developments of the War by sea and by land, Dr. Cody asserted with pride that Britain was still "Mistress of the Seas." With the exception of a few piratical submarines, the German navy was bottled up, and British commerce was free. He expressed the opinion that ultimately the issue of the War would be determined by sea power. On land, all of Germany's original plans had miscarried. The enemy had failed at Nancy, Paris and Soissons; he had failed at Dunkirk and Calais, and in the East in Poland and Galicia.

The Real Issues of the War

Among the real issues of the War were these: Is Europe to be governed by public law or by the right of the strongest? By Treaty rights or by State interest? Britain held the former ideal: she placed her all upon the foundation of the sacredness of treaty rights, and on the principle that the moral obligation between nations must be held inviolable.

The second issue with which Great Britain was concerned was the status of the little nations. Should there be one nation running over the whole of Europe like a great steam-roller, or should the liberty of the smaller nations be preserved? Britain was on the side of the smaller nations. The part played by the smaller nations had been an important one in the world's history: little Palestine had given us our religion; little Greece had given us our ideals in art and literature. As for Belgium, generations yet unborn would arise and call her blessed. Her choice lay between honour and dishonour, and she had chosen the former, paying the price with the terrible desecration and destruction of her all.

The critical character of the struggle in relation to the British Empire came in for special emphasis by Dr. Cody. France and Russia might survive defeat, but for Great Britain to be vanquished would mean the end. And what would be more natural than that Germany should turn at once to Canada, which, by its own assertion, was the greatest over-seas colony in the world? It had been suggested that in any event the United States would stand behind Canada. What protection could the United States afford us, with Germany bent upon aggression? The Monroe doctrine would be more powerless than even a "scrap of paper" against a Germany which had vanquished Europe.

Great Britain's High Ideals

Great Britain had ever stood for the highest ideals, and her governing characteristics had always been trustworthiness and trustfulness: she had been trustworthy in her dealings with other nations; trustful in her treatment of her subjects. The foes of a decade removed were now in arms against the German aggressor.

Dr. Cody closed with a stirring rally-call to the Flag, in whose honour the following verses had been written by Canon Scott, of Quebec, now serving with the Canadian forces on the battle-line—

The Colours of the Flag

What is the blue on our flag, boys?
The waves of the boundless sea,
Where our vessels ride in their tameless pride,
And the feet of the winds are free;
From the sun and smiles of the coral isles
To the ice of the South and North,
With dauntless tread through tempests dread
The guardian ships go forth.

What is the white on our flag, boys?
The honour of our land,
Which burns in our sight like a beacon light,
And stands while the hills shall stand;
Yea, dearer than fame is our land's great name,
And we fight, wherever we be,
For the mothers and wives that pray for the lives
Of the brave hearts over the sea.

What is the red on our flag, boys?
The blood of our heroes slain
On the burning sands, in the wild waste lands
And the froth of the purple main;
And it cries to God from the crimsoned sod
And the crest of the world outrolled
That He send us men to fight again
As our fathers fought of old.

We'll stand by the dear old flag, boys,
Whatever be said or done,
Though the shots come fast, as we face the blast,
And the foe be ten to one—
Though our only reward be the thrust of a sword
And a bullet in heart or brain,
What matters one gone, if the flag float on
And Britain be Lord of the main!

Frederick George Scott.

The close of Dr. Cody's address was marked by an enthusiastic demonstration on the part of the members. A vote of thanks was moved by the City Works Commissioner, Mr. R. C. Harris, and seconded by Mr. T. S. Young. Mr. W. A. Bucke, First Vice-President of the Club, was in the Chair.

Mr. C. D. McArthur, of Halifax, of the contracting firm of Foley Brothers, Welch & Stewart, gave an illustrated address, "The Use of Steel Forms for Concrete," at a recent meeting of the Nova Scotia Engineering Society.

Mainly Constructional

East and West — From Coast to Coast

The Nanaimo Paving Company, Limited, is a new Vancouver concern incorporated with a capital of $30,000.

Among the items included in the Dominion Government estimates is $350,000 for harbor improvements at Vancouver, B.C.

At a special meeting of the Dominion Bridge Company, held in Montreal, authority was given to enter into the manufacture of guns and ammunition.

The Fairview Sand and Gravel Company, Limited, has been incorporated with a capital of $25,000. The head office of the concern will be at Vancouver.

Edmonton, Alta., is putting paving work in hand this spring estimated to cost $130,000. Details are in the hands of the City Engineer, Mr. Latornell.

Halifax is adding to its municipal engineering activities, sewer extensions estimated to cost $150,000. The City Engineer, Mr. T. W. W. Doane, will direct the work.

At Peterborough, Ont., the City Council has started work on the construction of a sewage disposal system estimated to cost $100,000. The work is under the direction of the City Engineer, Mr. R. H. Parsons.

The Paving and Construction Company of Canada, Limited, Montreal, has been incorporated with a capital of $100,000. The incorporators include L. H. Durand, J. A. Boutet, and B. Brault, all of Montreal.

The Dominion Railway Board has granted the application of the City of Toronto for the approval of its plans for the construction o a subway under the Grand Trunk tracks at the proposed extension of Wilton Avenue to connect with Dickens Street.

The C. P. R. have instructed Messrs. Darling & Pearson, Toronto, to draw plans for a new station at North Toronto The tenders will be received at the end of July by Mr. D. H. Mapes, engineer of buildings, Windsor Station, Montreal. The estimated cost is $200,000.

Among the larger building jobs on which contractors are now figuring is the armoury at Calgary, Alta., estimated to cost $350,000. The site for this building has been donated by the City Council. The actual building will be erected by the Dominion Government.

Messrs. R. S. and W. S. Lea, consulting engineers, Montreal, are preparing a preliminary report on means to improve or to replace the present pumping plant for the supply of water for Three Rivers, P.Q. The report is being made on instructions from the City Council.

In future, tenders for the supply of asphalt to the City of Montreal will be open to all firms, the agreement for the present supply having expired. The Controllers have drawn up a set of specifications, but at the same time are open to consider supplies based on specifications by bidders. Analyses of the material will be made by McGill and Laval Universities.

Rail laying has been started with the advent of spring weather on the Kettle Valley Railroad in British Columbia, and it is expected that the last link in the connection with the main line of the Canadian Pacific Railway will be completed by June 1, in time for the inauguration of regular service when the new summer schedule becomes effective on the main line. The bridge over the Fraser River near Hope, which connects the main line of the Canadian Pacific Railroad with the new Hope Mountain line, has been completed, and rails have been laid across the river as far as the crossing of the Canadian Northern Railway.

Five tenders for paving were received by the Maisonneuve Council. After considerable debate, the contract was awarded to the Paving and Construction Company of Canada, Limited, this concern having agreed to comply with the stipulation that local labour only be employed. One tender for asphalt work was rejected on the ground that the offer was absurdly cheap, an alderman remarking that the Council did not want to ruin the contractor. The Mayor suggested that the entire work should be done by day labour, but a member of the Council made a strong protest against this, declaring that it was not fair to change the method of work after inviting contractors to bid and keeping them waiting on the Council for six weeks. The idea of day labour found only two supporters.

In a recent letter to the City Clerk of Ottawa Mr. Allen Hazen, of New York, sets forth his views on the water supply situation in the Federal capital. Three possible sources of water supply are under consideration—unfiltered water from Thirty-One Mile Lake, unfiltered water from McGregor Lake, and filtered water from the Ottawa River. In Mr. Hazen's judgment these three waters would all be of the same quality. No one could tell one from another except by careful chemical analysis. The McGregor Lake supply, Mr. Hazen believes, is the best for the city to adopt if the requisite rights can be secured on attractive terms. Otherwise mechanical filtration of the Ottawa River is preferred. The Thirty-One Mile Lake scheme is dismissed by Mr. Hazen on account of its excessive cost, $8,000,000.

While the prospects for extensive building in Montreal are not particularly good—the permits for last month at $245,695 declined by $603,231 as against tha same period in 1914—supply houses report that the inquiries from the country districts are very encouraging. A large amount of building is in sight in the province of Quebec, churches and schools forming an important factor in the programme. In addition to the extensive road construction proposed by the Provincial Government, the Federal Government have in view some large works. The present moment is emphatically the time to build, for materials and labor are comparatively cheap, and if the cities are not alive to the opportunities for obtaining structures at low cost, there would appear to be, from the inquiries, many in the country districts who are keen to invest capital with every promise of a very satisfactory return.

The building trade in Montreal continues to be quiet, and there are very few important jobs either in hand or in sight. The city has mapped out a fairly large programme of public works, and will require a considerable amount of road material. At the time of writing the civic library has been held up, pending the receipt of further information from the Controllers, and it would not be surprising if the scheme fails to materialize this year. The Bank of Toronto is proceeding at a good rate with its new building on McGill Street, the steel being now up. A. F. Byers & Company have commenced operations on the three-storey Bancroft

School, on St. Urbain Street, the cost being estimated at $200,000. Another school, to cost about the same sum, will be built on Bloomfield Avenue, Outremont. Plans have been drawn for a school and residence on St. Andre Street, the building to be of pressed brick and grey sandstone, hollow tile and steel construction. A large number of churches and schools are being erected throughout the province of Quebec, some of them being of fairly large dimensions. In Montreal, the contract for the St. Denis Theatre has gone to Norcross Brothers and Company, Limited; the estimated cost being $300,000. Messrs. E. G. M. Cape, Limited, have obtained the contract for the addition of a wing to the Royal Victoria Hospital, the construction being stone and fireproof, in keeping with the present institution. A moderate amount of general work is in hand, but it is mainly on structures which were commenced last year.

A steel tower 120 ft.. high, supporting a 50,000-gal. water tank, has just been successfully moved about 200 ft. by Messrs. Beaton & McLeod, contractors, in Fort William, Ont. The tower is the property of the Ogilvie Flour Milling Company, Limited, and was on the site of the contemplated 250,000-bu. addition to their elevator, which addition is now being constructed. After new bases had been prepared for the tower, moving was begun. The top of the tower was securely guyed in four directions by ¾-in. steel cable, which was carefully played out, or taken up, as the tower moved, by means of a set of falls at the lower end of each guy. The feed pipe and frost box in the centre of the tower were supported on cross timbers. The four posts of the tower, which were 30 ft. apart on each side, were made up of two channels each. To these posts were bolted 8 x 16-in. timbers, 40 ft. long, which were used in jacking up the tower to put rollers under it. The track was composed of 12 x 12-in. timbers placed on the frozen ground and levelled up with blocks. The skids placed under the tower posts were two 8 x 14-in. timbers 40 ft. long, each having two maple shoes 3 x 12 in. x 14 ft. long. The rollers were of maple, 7 ins. in diameter and 6 ft. long. Transverse timbers 8 x 14 ins. were used to keep the tower posts from spreading. Power for hauling was furnished by a team, attached to a ⅞-in. rope, which worked through a pair of double blocks. This tackle was used as a luff on the main ¾-in. steel cable, which worked through a pair of triple blocks. Seven men were employed, and the entire operation required about five days. The actual time of moving, however, was only 3½ hours .

French Inquiry for Construction Materials

HON. Philippe Roy, the Canadian Commissioner General at Paris, has forwarded a copy of a communication from an engineer in that city engaged in public works and the building trade who desires to have the attention of Canadian manufacturers and dealers drawn to his probable requirements for the near future. In anticipation of the developments which will be brought about by the repair of lines of communication and the reconstruction of the public works and buildings destroyed by the war, it is expected that the following materials will be required in considerable quantities at an early date:—

Lumber, squared and logs, for frame work and joinery.
Sectional iron and steel for frame and railways.
Machine tools for timber.
Machine tools for iron.
Metallic bridges and frames, fixed and adjustable.
Lumber bridges and frames, fixed and adjustable.
Lifting apparatus, such as cranes, trucks, crabs, etc.

Tools for earth-work, quarries, pile-drivers, such as steam clams and shovels, perforating machines, mining crowbars, shovels, picks, etc.

Tools for the crushing of stone.

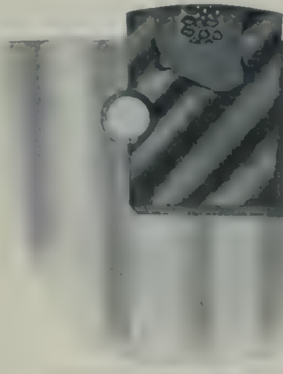
Tools for the manufacture and utilization of mortar and concrete.

Transportation material used on public works stock yards, such as wagons, portable railroads, locomotives and locomobiles, auto trucks and carts, wheelbarrows, etc.

The engineer inquiring for these materials requests interested Canadian concerns to forward their catalogues and other particulars, so that he may be in a position to place immediate orders when the occasion arises. The name and address of the engineer in question may be had on application to the Department of Trade and Commerce, Ottawa. (Refer file No. A 935.)

Messrs. Estey Bros. Company, 2 St. Cecile Street, Montreal, have commenced the erection of the architectural iron and bronze work at the new Customs House, Ottawa, for which P. Lyall & Sons Construction Co., Ltd., are the general contractors. The architectural iron and bronze work is of an unusually elaborate character, the main stairs being entirely of bronze.

Stone firms and contractors will be interested in a new diamond saw tooth invented by the George Anderson Company of Canada, Limited, Montreal, and patented in this country and the United States. The great merit of the invention is the saving in the cost of cutting by 50 per cent. Instead of containing, as in the old method, one solid diamond, the tooth has a number of small pieces in layers totalling the usual weight. The diamonds are inserted in a broken condition, and reinforced with steel, and as the first layer is worn away, the second comes into cutting action, and so on. until the teeth are worn away. This arrangement obviates loss through entire or partial breakage, and is therefore more economical than the old system. The company have made extensive experiments, and are convinced that the tooth will fulfil all the advantages which is claimed for it. It will do as much work in cutting soft stone as a tooth containing a solid diamond, and more in cutting hard material, losses through fracture being eliminated by the reinforcement.



Reinforced diamond saw tooth.

Messrs. Clarke & Clarke, general contractors, late of North Bay, have opened offices at 43 Victoria Street, Toronto.

W. J. MacDonald, a well-known railway contractor, who for some years had made his home at Moulinette, Ont., died last week at St. Petersburg, Florida. The late Mr. MacDonald was connected with the contracting firm of Ryan & MacDonald, which built an extensive section of the G. T. P. north-west of Quebec City. He was also identified with the Saguenay Construction Company, which built the most difficult section of the Quebec and Saguenay Railway. He had been associated with the firm of M. P. & J. T. Davis in the construction of much important hydraulic and canal work.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Dundas, Ont.
The Town Council have had plans drawn by McPhie, Kelly & Darling, Bank of Hamilton Building, Hamilton, for extensions to the waterworks, including a new storage dam and the resurfacing of the old reservoir. Estimated cost, $6,000. Engineer of Public Utilities Commission, R. W. Karch.

Dunnville, Ont.
The Town Clerk, W. J. Holmes, will receive tenders until noon, April 19th, for the construction of sewers on Canal Street. Plans and specifications at the office of the Town Engineer.

Fort William, Ont.
The waterworks extensions will be done by day labor under the supervision of City Engineer R. R. Knight. The contract for the supply of pipe has been let to the Canada Iron Corporation. Estimated cost, $65,000.

Hamilton, Ont.
Tenders will be received until 5 p.m., April 27th, by the Cley Clerk, for the installation of the following equipment at the Gage Avenue Sewage Pumping Station:—one centrifugal pump for raw sewage, capacity 8,000,000 gallons per day, and one synchronous motor, 150 h.p., with stitching apparatus and all accessories for direct connection to centrifugal pump. Specifications at the office of City Engineer Macallum.

Hull, Que.
The Hull Electric Railway Company, Main Street, contemplate laying tarvia roadways in connection with their track work on various streets.

New Westminster, B.C.
The City Council are about to start laying a macadam pavement on Sixth and Carnarvon Streets. Work to be done by day labor. Estimated cost, $9,000. Engineer, T. M. B. Blackman.

North Gosfield Township, Ont.
Tenders will be received until April 24th by W. H. Noble, Cottam, Ont., for 1,000 rods of ditching in connection with repairs to Buscomb Drain for the Township Council. Engineer, Owen McKay, P. M. Railway Building, Walkerville.

Oakville, Ont.
The Town Council have approved an item of $9,910 for the construction of sewers on various streets. Clerk, W. E. M. Crawley.

Ottawa, Ont.
The Department of Public Works, Ottawa, have included $20,000 in this year's estimates for extensions to the concrete walls of the Rideau Canal adjoining the Government Driveway. Secretary, R. C. Desrochers.

Peterboro, Ont.
The City Council have started work on the construction of an outfall sewer, consisting of one mile of monolithic reinforced concrete pipe, 3 feet in diameter. Plant will be erected later. Engineer, R. H. Parsons.

Richmond, B.C.
The Municipal Council contemplate extensions to the waterworks system at a cost of about $40,000. Clerk, G. S. Willson.

Stamford Township, Ont.
Tenders will be received until the second week in May by the Township Clerk, C. F. Munro, Southend P. O., for various kinds of paving. Approximate cost, $25,000. Plans and specifications with the Engineer, J. C. Gardner, Queen Street, Niagara Falls.

Stratford, Ont.
The City Engineer, A. B. Manson, will receive tenders until 5 p.m., April 17th, for the construction of approximately 13,000 feet of concrete curbs and 2,400 feet of combined concrete curbs and gutters.

The City Council will receive tenders until April 17th for the construction of 5,460 feet of concrete sewer pipe of various sizes. Estimated cost, $72,000. Engineer, A. B. Manson.

Three Rivers, Que.
The City Council are having a preliminary report prepared on the improvement or replacing of the present waterworks plant. Consulting Engineers, R. S. & W. S. Lea, 10 Cathcart Street, Montreal.

Victoria, B.C.
The construction of a section of sidewalk on the south side of Fisgard Street has been approved by the City Council. Engineer, C. H. Rust.

Railroads, Bridges and Wharves

St. Anne de Beaupre, Que.
The sum of $19,000 for repairs to the wharf here has been included in this year's estimates by the Department of Public Works, Ottawa. Secretary, R. C. Desrochers.

Vancouver, B.C.
The Dominion Government Department of Public Works have included $350,000 in this year's estimates for improvements to the harbor. Secretary, R. C. Desrochers, Ottawa.

Victoria, B.C.
The City Council are having plans prepared for a swing span bridge to replace the Rock Bay Bridge and will start construction shortly. Engineer, C. H. Rust. Estimated cost, $7,500.

Public Buildings, Churches and Schools

Ange-Gardien, Que.
The Secretary to the School Board, P. Gariepy, will receive tenders until April 20th for the construction of an annex and repairs to the old school.

Ashton, Ont.
Tenders for the construction of a church will be received by the Rector of the Presbyterian Church. Architect, J. W. H. Watts, Central Chambers, Ottawa.

Aurora, Ont.
Tenders on the installation of interior fittings at the local Post Office will be received until 4 p.m., April 22nd, by the Department of Public Works, Ottawa. Plans and specifications at the offices of H. H. Coffey, Clerk of Works, Aurora, T. A. Hastings, Clerk of Works, Postal Station F, Toronto, and at the Department, Ottawa. Specifications at the office of MacLean Daily Reports, 25 Charlotte Street, Toronto.

Battenburg, Alta.
Tenders on the erection of a frame school will be received until noon, May 1st, by the Trustees of the Heathfield School District No. 3154. Treasurer, A. McIntyre, Battenburg.

Beverley, Alta.
Debentures to the amount of $25,000 have been issued by the Beverley School District No. 2292 for the erection of a four-roomed brick school. Chairman, T. R. Dando.

Chatham, Ont.
Wilson & Son, architects, King Street, will receive tenders until April 20th for raising McKeough School a height of three feet.

Esquesing, Ont.
The Councils of Esquesing and Massagaweya Townships are about to organize a new School Section. Trustees will be elected this month and arrangements made for the erection of a school. Clerks,—Esquesing, J. A. Tracy, Esquesing; Massagaweya, John Marshall, Campbellville.

Hanover, Ont.
Tenders on the installation of interior fittings in the Post Office and Customs House here will be received until 4 p.m., April 22nd, by the Department of Public Works, Ottawa. Plans and specifications at the offices of J. Telford, Clerk of Works, Hanover, T. A. Hastings, Clerk of Works, Postal Station F, Toronto, and at the Department, Ottawa. Specifications at the office of MacLean Daily Reports, 25 Charlotte Street, Toronto.

London, Ont.
A site has been secured by the Independent Order of Oddfellows and a committee appointed to make arrangements for the erection of a lodge hall. Secretary, Dr. C. G. Jarvis, 715 Dundas St.

Ottawa, Ont.
Alterations to the Forward Street School are contemplated by the Separate

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An Interesting Decision Affecting Contractors

THE Court of Review sitting at Montreal recently handed down a decision which sounds a warning note to contractors, especially at a time when discretion in regard to payments may be subordinated to keenness to lead in the competition for new work. The facts are, briefly, that the County of L'Assomption wanted a bridge. The members of the County Council hobnobbed for awhile, discussed the project from every point of view, and finally decided that the county must and should have a bridge. They were confident that the Government would contribute towards the structure, and they drew up a sort of assessment roll showing just how much each of the ratepayers should pay towards the building of the bridge; but instead of calling for tenders, they delegated their powers to the parish council of L'Assomption, within whose boundaries, it would appear, the bridge was to be located, although the structure was for the general benefit of the county traffic. The Parish Council, acting upon the authorization given it by the County Council, called for tenders, and accepted a bid submitted by one F. R. Riopel. The contract was drawn up, and it was stated that the Provincial Government was to contribute $10,000 to the work. With this in mind the contractor decided to proceed with the job, putting up the money himself. The work went on, and in due course the bridge was completed and ready for traffic. In the meantime, however, one of the ratepayers who had been slated to contribute to the work took action before the courts, attacking the right of the County Council to delegate its powers to the Parish Council, and as a corollary impugning the right of the Parish Council to give out a contract.

The plaintiff lost in the lower court, but the Court of Review has reversed the finding and upheld the plaintiff throughout.

The question arises, Where does the contractor come in? We may assume that some kind of an adjustment will be made eventually, but it may be only after the most wearisome processes. The bridge has been built, and it has been declared that the Parish Council had no authority to enter into the contract—all of which emphasizes the point that it is as much the part of a contractor to be possessed of keen business acumen in regard to the financing of any proposition that he undertakes as it is for him to have the practical experience to carry it out. It is poor satisfaction indeed to have to rely upon the stingy verdict of a law court after spending much good money on the execution of some contract—perhaps at a loss.

Better go to law before undertaking a job than afterwards. The leeches draw less out of you.

Progress of the Maritime Provinces

THE Maritime Provinces of Canada—Nova Scotia, New Brunswick, and Prince Edward Island—are closely linked together. Nova Scotia, largely because of its coal mines and of its two great steel companies, leads as a manufacturing and mining province, but Prince Edward Island and New Brunswick reap a very considerable benefit by the consuming market for farm products which these industries have provided. Fishing, an important industry in all the provinces, and lumbering, perhaps the foremost industry of New Brunswick and an industry of no mean proportions in Nova Scotia, contribute to the extent of the consuming market. The three provinces combined make up an entente of a very striking character. Producer and consumer minister to and supply the needs of each other, and recognise their mutual dependence. A few figures strikingly illustrate the recent industrial development in these provinces. In 1901 the value of the combined output of the factories and workshops of the Maritime Provinces was £9,377,338. By 1911 these figures had increased to £18,252,991. The mineral output in the same period had increased from £1,941,683 to £3,629,247—an almost corresponding increase, i.e., nearly 100 per cent. Since 1911 each of these important lines of industry has added to their output nearly 25 per cent. Figures relative to agricultural production are not so easily accessible, but each province has witnessed a marked development.—The Colonist, London, Eng.

Engineering Topics in the Old Land

A Discussion of the Symposium on "The Possibilities of Developing Trade Within Canada and the Empire" Published in The Contract Record of Feb. 17 last.

By the London (Eng.) Correspondent of this Journal

THE place of honor on this occasion must be accorded to the "Symposium on Trade Development," which appeared in the Empire Number of the Contract Record. It is a most valuable contribution to engineering (and commercial) literature, and although appearing in the columns of a weekly journal, the adjective ephemeral is the very last that could be applied to it. Words are the most elusive and the most evasive of things. They mean one thing in one age and another in another, and their original derivation is only too often lost or obscured. Symposium, derivatively speaking, means a drinking together, a banquet of compotations and merry-making, a convivial meeting; at all of which any question such as that of the possibilities of trade-development would be sternly taboo. But the word obtained a wider and a more serious meaning, and came to be applied specifically to banquets at which philosophic discussion was the main feature (the symposium being essentially the intellectual side of the feast), and at these trade-development might possibly have formed a theme for discussion. The word as now used signifies such a collection of brief essays and articles on the same subject, by different writers, as the Symposium under consideration. It was a dangerous experiment, in a way, on the part of the editor, for words, like species, are apt at times to "throw back," and the writer was quite prepared to be faced with a banquet consisting in the main of patriotic compotations and perfervid merry-making of the flag-waving type. Instead he has been regaled with philosophic discussion of quite a high order, and he is proportionately grateful.

Awakening of the Empire

Now the war should not, of necessity, have had any bearing upon the preparation of the Symposium. The Empire is the Empire, Canada is Canada, whether at peace or at war, and what is good for the one time is good for the other. Mr. W. H. Carter hit the nail squarely on the head when he said "The possibilities for trade development within the Empire are not essentially different from those that existed before the opening of the European war; in fact, it is recognized everywhere that these possibilities have only been accentuated by the new and changed conditions." As a matter of fact, the Empire, including Canada, was fast settling down into a pleasant nap, when the thunder of Continental artillery awakened it. The wonderful possibilities of the Empire had never been seriously considered, and to hint at a self-supporting Empire was to court laughter and contempt. Germany, it was always felt, could not be left out of the reckoning, for without her could any country live? Recent events have disposed more countries than one at least to endeavor to do without her, although what may come to pass when peace is declared none can forecast.

Canada in the Empire

"Canada uber Alles" is felt by the contributors to the Symposium to be a futile cry. With the sentiment of the Premier every Canadian must agree. "I stand," says he, "in the first place for the Empire as against the World; and within the Empire I stand first for Canada." In every patriotic movement there is the danger of excessive narrowing down, and Sir Robert Borden's manly utterance is a timely one. Mr. A. Hutchison voices the same cry. The contribution of Mr. John S. Archibald hits the mark when he says that the development of trade within the Empire must proceed along lines purely of merit, and not under the guise of patriotism. "This word," he continues, "is being misused today to cover all the shortcomings of the manufacturing world in Canada. We are being deluged with advertising matter calling upon us to use and specify Canadian-made goods in the name of 'patriotism.' It appears to me that patriotism is to be found entirely on the side of the consumer. The manufacturer spends his time in waving the flag with one hand and boosting prices with the other, and you will usually find that when patriotism interferes with profits, he throws the former overboard and hides himself behind the screen of the necessity of fostering home industries." The first of the two excellent "cautions" administered by Sir George E. Foster is upon somewhat similar lines, only his language is more restrained. Writes Sir George: "The patriotic impulse map help to excuse, for a limited time, crudeness of make, and comparative lack of quality, but will not carry further. The wares must be up to the mark and reasonable in price, or the economic impulse will prompt customers to seek what they want where these two qualities are found. Neither the flag nor the hurrah will suffice to excuse lack of good workmanship or extravagance of price." The Made-in-Canada campaign has, it is to be feared, been entered upon without due foresight and consideration. "There is," says Mr. J. B. Carswell, "a very grave danger, in our enthusiasm, of carrying this campaign far beyond the limits of its practicability. The subject suggests a much better title, 'Made in the Empire,' for we must remember that Canada in its present stage of development cannot supply all her own wants, nor will she be able to do so for many years to come. I have no doubt that the present effort was well timed, in fact it was greatly needed, but let us beware of causing premature births of, and unnatural forced growth in industrial activity, which would most assuredly be disastrous in the long run." His stricture upon the Canadian hardware man who "appeals to our patriotism, turns out an inferior article to that of the United States manufacturer, and pockets the Government's tariff" gives one furiously to think! A Made-in-Canada trade mark may be an excellent idea, so long as a high standard of goods can be maintained ("goods of the right quality at the right price," as Mr. R. W. Ashcroft phrases it), but once let the standard sink and the mark is besmirched for all time. "Made in Germany" has not usually been regarded as a recommendation! The course would certainly be a risky one. To quote your own leading article: "We are all good Canadians, and we would all see Canada occupying a position of pre-eminence in the Empire, but certain it is that such position can only be attained by virtue of honest achievement and not by any selfish policy of Dollars First and Reputation Last. We can only expect a demand for "Made-in-Canada" goods proportionate to the high quality and reasonable prices of the various lines of manufacture." In the maintenance of a high ideal and in extensive advertising lie, as you say, greater elements of success than what could be obtained from the mere use of a trade mark.

Engineering Possibilities

Coming now from the general to the particular, the engineering phase of the subject merits close attention, and it is a satisfaction to the writer to note that many of the matters touched upon in his contribution to the Empire Number have also had their place in the concurrent Symposium. Thus, the possibilities of developing a trade in wood paving blocks is referred to on several occasions in the Symposium, notably in the contributions of Messrs. Lucius E. Allen, G. A. German, W. C. F. Gillam, and R. H. Parsons. It does seem a bit "off" that a timber-producing country such as Canada should obtain wood paving blocks from the United States, even though only "to get quick delivery." There would seem to be no reason, judging from the favorable reports received from various parts of the Dominions, why Canada should not be self-supporting (leaving on one side any question of export) in such goods as "Portland" cement, lime, plaster of paris, clay and stoneware goods, terra cotta, marble, roofing materials, steel plates, steel tubes and sections, and tools. A large proportion of the machinery, too, which is at present imported, might be made in the country. "From personal observation," says Mr. Lucius E. Allen, "the writer was impressed with the fact that while the manufacture of Portland cement was first started in England, the general and varied use of concrete, reinforced concrete, etc., does not seem to be so general in Great Britain as in Canada, and the use of modern concrete machinery does not seem to be so extensive. Why not cultivate this extensive market?" Again, referring to road-making work, Mr. W. A. McLean points out that this is developing into an undertaking of large proportions, to be carried out by means of specialized plants of machinery and equipment. "More," he adds, "may be anticipated in cost reduction from machinery development than from any other discernible source. Machinery for the cheaper and more efficient construction of bituminous roadways in the open country can be developed profitably. Machinery of a lower cost for handling broken stone from the car or stock pile to wagons would fill an important need, as manual labor in this work is inefficient and expensive. A machine is needed, easily portable and of comparatively low cost, such as county and even township authorities can afford to purchase and operate. Road construction is a matter which must find increasing support as the years roll on. There will be a growing demand for machinery throughout Canada for this purpose. Australia, South Africa, India and all the lesser colonies are feeling the impetus to road improvement. To satisfy this market within the Empire, on a broad scale, should be financially profitable and attractive. It can only be done, however, by men and firms who are willing to study the road situation, and to supply such machinery (and only such machinery) as will in the end prove satisfactory to their customers—corporations, engineers and contractors." Mr. George Reakes holds the same opinion, and is convinced that "all classes of stone crushers and road machinery could be manufactured here, instead of being imported from Germany and the United States."

Establishment of Permanent Industries

There is no necessity further to labor the matter. The only point remaining is: How is all this to be done? Writers to the Symposium talk of Government Commissions, Government Bulletins, and abolition, strengthening or preferentializing of tariffs, and so on and so forth. Clearly, the war has shown what can be done. "I am informed," says Mr. Walter J. Francis, "that war contracts to the extent of two hundred million dollars have come to Canada since hostilities began. The manner in which one hundred and fifty of our manufacturing shops have taken up the manufacture of shells in the past few months is little short of marvellous. The ingenuity displayed in adapting railway shops, bridge shops and machine shops to shell-making, shows more clearly than almost anything else could have done, the ability of Canadian engineers to rise to opportunities." But opportunities, the war over, may not occur again, and what the Canadian manufacturer has to do is to create them for himself. His reliance must be upon himself and upon himself alone; Governments are notoriously unreliable and their well-meant assistance is only too often a real hindrance to trade. Technical training will do much, as Mr. E. T. Nesbitt points out, and much more must be done in this direction than has been done hitherto. But after all is said and done, competition must remain the most potent factor. "Just as long," says Mr. C. C. Clark, "as Canadian people buy inferior articles at fancy prices because they are made at home, and thus discourage legitimate competition from the remainder of the Empire, so long will the quality of goods manufactured in Canada improve very slowly. Competition is absolutely necessary if we are to have healthy trade." Sentiment must practically be ruled out, except that phase of it which inculcates good wages, decent conditions of living and humane treatment of the workers. Patriotism of the flag-waving type, too, is a non-essential, and it must be remembered that no amount of ornate, highly-colored, crossed-flag note-heading will compensate for inferior production. Above all, the English-speaking, Empire-subject manufacturer must be encouraged to enterprise within the Dominion. Every facility must be given to him, every encouragement held out to him, to open up factories, and to lay down plant and machinery, for by this means the day when the Canadian can look after himself will arrive all the speedier.

The most valuable of the "valuable deposits untouched and in many cases unknown, from the Atlantic in the east to the Pacific in the west, from the Maritime Provinces to Manitoba, to Saskatchewan, to Alberta, to the foothills of the Rockies, and back again to old Quebec and to Ontario," are the resource and the alertness of the people. These will repay working to the full, and the result will be the establishment of such a host of permanent industries as it would be premature now even to dream of.

Method and Cost of Making Test Borings for the Winnipeg Shoal Lake Aqueduct*

By Douglas L. McLean, Assistant to the Chief Engineer

IN connection with the extensive field investigations undertaken by the Greater Winnipeg Water District and pushed forward under the direction of W. G. Chace, Chief Engineer, during the winter of 1913-14 for the location of the aqueduct and appurtenant works from Intake Site, Shoal Lake, to the city of Winnipeg, considerable boring and test pit work was carried out. At the Intake Site and the Falcon River Crossing a number of wash borings were made by Party No. 3, of which the writer had charge. Hand auger borings were also made by this party for the location of the aqueduct from the intake across the summit some ten miles westward to Boggy River. Mr. R. T. Sailman, who had considerable experience on deep drilling in New York state, was detailed from the head office to assist on this work, as well as to look after the entire underground explorations along the line to Winnipeg.

Table I.—Hand Auger Test Boring Cost Data, Winnipeg Aqueduct

(Small "Empire Drill" earth auger used without casing as hand auger).

	Totals
Number of holes	29.0
Frost depth in feet, 1	55.9
Peat depth in feet, 2	234.1
Sand and gravel depth in feet, 3	0.9
Clay depth in feet, 4	409.7
Total depth in feet of 1, 3, 4	465.5
Total depth in feet of 2, 3, 4	644.7
Number of men per day or man-days	65.8
Cost per day	$208.66
Work done from February 4-28—	Feet.
Average depth frost per hole	1.93
(This is frozen peat and water)	
Average depth of peat per hole	8.07
Average depth sand and gravel per hole	.03
Average depth clay per hole	14.10
Average total depth	22.20
Average cost per foot run, 1, 3, 4 cts.	44.8
Average cost per foot run, 2, 3, 4 cts.	32.4
Average cost per man-day	$3.175
Average man-days per hole	2.27
Average man-days per foot run, 1, 3, 4	0.141
Average man-days per foot run, 2, 3, 4	0.102
4-men gang—	
Average cost per day	$12.70
Average bored, 1, 3, 4 feet per day	28.4
Average bored, 2, 3, 4 feet per day	39.2

Note.—Cost of auger, axes, etc., not included in table.

These holes were about 2,000 ft. apart and considerable time was required transporting outfit and travelling to camp.

This work was carried on under the severe climatic conditions of a Manitoba winter. Maximum ice conditions on Shoal Lake from December, 1913, to June, 1914, are shown graphically in Fig. 1. The chart shows the growth of the ice from day to day on an ice space kept clear of all snow. Corresponding to the curve of ice thickness is a temperature curve to show the amount of cold which produced this ice. In order to measure this in degrees below freezing over a stated period, the ordinates for the curve were taken as "degrees Fahrenheit below freezing times one day." The maximum depth of ice on snow covered portions of the lake was 2.3 ft. thick as compared to 3.2 ft. on clear space. On the peat bogs the depth of frost averaged about 2 ft. The maximum depth of frost encountered was 3.7 ft. in sandy soil while the minimum in sheltered snow covered places was 1.5 ft.

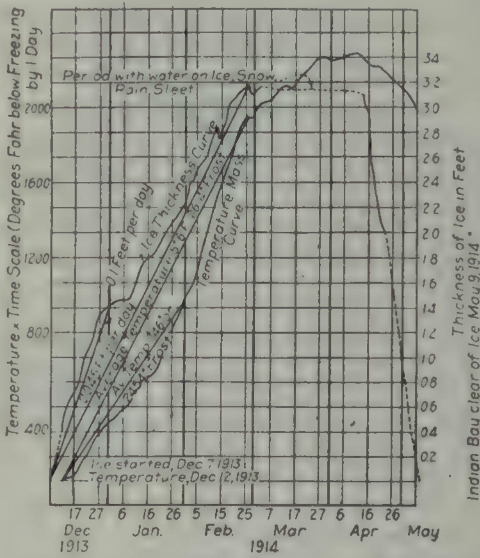

Fig. 1. Ice thickness and temperature curves for Indian Bay, Shoal Lake, Greater Winnipeg Water District 1913-14.

Ice thickness measured on clear ice area 100 ft. x 50 ft. and each measurement taken at a new hole each day. Temperatures taken at 7 a.m., 12 noon, and 7 p.m. Average of these taken for daily mean.

The located line for the section of the aqueduct on which Party No. 3 made borings ran for the most part through a clay country covered with peat bogs. For the seven miles from Snake Lake to the Boggy River the peat bog averaged about 8 ft. in depth.

Cost data relating to a portion of the test boring work is given herewith under the following headings: (1) Salaries and board allowances. (2) Empire drill costs. (3) Hand auger costs. (4) Wash boring costs.

Salaries and Board Allowance.—The following

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* Courtesy of Engineering and Contracting, Chicago.

Table II.—Hand Auger Test Boring Cost Data, Winnipeg Aqueduct

	Total	Totals to April 22
Number of holes	396.0	370.0
Frost depth in feet, 1	759.6	759.6
Peat depth in feet, 2	2,608.9	2,490.9
Sand and gravel depth in feet, 3	59.3	59.3
Clay depth in feet, 4	3,530.8	3,352.3
Total depth in feet, 1, 3, 4	4,349.7	4,171.2
Total depth in feet, 2, 3, 4	6,199.0	5,902.5
Number of men per day, man-days	245.9	236.9
Cost per day	$690.10	$662.70
Summary of results to April 22—		
Average depth frost per hole, feet		2.05
Average depth of peat per hole, feet		6.73
Average depth of sand and gravel per hole, feet.		0.16
Average depth of clay per hole, feet		9.06
Average total depth, feet		15.95
Average cost per foot run of 1, 3, 4 cts.		15.9
Average cost per foot run of 2, 3, 4 cts.		11.2
Average cost per man-day		$2.80
Average man-days per hole		0.64
Average man days per foot run, 1, 3, 4		0.057
Average man-days per foot run, 2, 3, 4		0.040
3-man gang—		
Average cost per day		$8.40
Average bored, 1, 3, 4 feet per day		52.8
Average bored, 2, 3, 4 feet per day		75.0
Cost of equipment—		
3 rod augers at $10.70		$32.10
6 spanners at 20 cents		1.20
3 monkey wrenches at 70 cents		2.10
1 pipe auger at $15.00		15.00
4 10-qt. galvanized pails at 21 cents		.84
1 doz. 3½-lb. axes at $1.00		12.00
Total		$63.24

This equipment cost is not included in table.

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were the standard rates paid by the Greater Winnipeg Water District:

Position	Rate
Instrumentman, per month	$100
Leveller, per month	90
Topographer, per month	75 to $80
Field draughtsman, per month	60 to 70
Rodman, per month	40 to 45
Head chainman, per month	40 to 45
Rear chainman, per month	35
Head picketman, per month	40 to 45
Cook, per month	60 to 75
Cookee, per month	35
Leader, per day	1.75
Laborer, per day	1.50

For the boring costs given in this article a board allowance of $1.05 per working day has been charged.

Empire Drill Costs.—Total and average costs for 645 ft. of boring using the small auger drill spoon with necessary drill rods, wrenches and handles of a Junior Empire Drill Set, are given in Table I. The Junior Empire Drill Set ordered by the district cost $259.85 delivered at Winnipeg. It was supplied by the New York Engineering Company, whose catalog gives a complete description of its various parts. The test holes put down were at 2,000-ft. intervals, averaged 22.2 ft. in depth and cost 32.4 cents per foot run, including the peat in the depth.

In opening up the holes through the frozen material axes were used on all hand auger work, as the axe was

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Table III.—List and Cost of Equipment for Making Wash Borings on Winnipeg - Shoal Lake Aqueduct

Quantity and Description	Unit Price	Cost
50 ft. 2½-in. extra heavy pipe (drive casing) in 5-ft. lengths	$0.57	$28.50
Cutting and threading pipe	....	5.00
50 ft. 1¼-in. heavy pipe, five 4-ft. lengths and six 5-ft. lengths	.25	12.50
Cutting and threading pipe	....	3.30
10 2½-in. couplings	.16	1.60
11 1¼-in. couplings	.08	.88
1 malleable 1¼-in. tee	.16	.16
1 double run 10-in. wooden block	1.85	1.85
60 ft. ¾-in. manilla rope, per lb.	.14	1.40
1 hand force pump R. 470—30 gals. per minute	7.00	7.00
2 24-in. Stillson wrenches	2.25	4.50
15 ft. 1½-in. discharge hose	.30	4.50
20 ft. 2-in. suction hose	.35	7.00
1 1¼-in. street elbow	.15	.15
1 1½-in. coupling for hose	.30	.30
1 2 x 1½-in. bushing	.10	.10
1 1½-in. short nipple	.10	.10
1 1½ x 2-in. nipple	.10	.10
1 drive weight 7 ins. diameter by 15 ins. long, 2-in. hole all the way through long dimension, widened to 3½ ins. from 4 ins. below top to top	....	......
3 ft. of ¼-in. flexible wire rope for handle.	5.60	5.60
2 1½-in. chopping bits of drill steel with 1¼-in. threads 8 ins. long	6.00	12.00
6 pairs lumbermen's rubbers, two buckles, sizes 10, 11 and 12	1.60	9.60
1 pipe vise to take 2½-in. to 1¼-in. pipe.	2.00	2.00
1 2-in. foot valve	.45	.45
1 machinist's hammer	1.10	1.10
2 cold chisels	.35	.70
1 pair jacks, 2 ins. by 18 ins., with handles.	6.8	13.60
Steel spindles for same, per lb.	.10	1.20
2 sleeve couplings, 1¼-in. W. T.	.10	.20
3 sleeve couplings, 2½-in. W. T.	.16	.48
2 1¼-in. nipples, 6 ins. long	.06	.12
2 1½-in. to 1¼-in. reducing couplings	.10	.20
2 1½-in. nipples, 6 ins. long	.08	.16
6 1-gal. pails	.21	1.26
1 pint machine oil, black	.15	.15
1 2-in. nipple, 6 ins. long	.10	.10
1 recovering tap	3.75	3.75
2 sister hooks	2.50	5.00
1 clasp for 2½-in. pipe	2.00	2.00
1 hoisting plug	1.75	1.75
6 couplings for 1¼-in. pipe (extra)	.08	.48
1 ice chisel	3.50	3.50
2 axes, 3½-lb.	1.25	2.50
1 air tight heater	2.10	2.10
1 length stove pipe	.10	.10
2 chain tongs, No. 33 Vulcan	4.50	9.00
2 pairs extra leather (front and back) for piston of Meyer's low-down force pump	.35	1.40
3 logs for tripod	....	......
Delivery from C. P. R. station to site (18 miles)	....	12.10
Total	....	$171.54

found more efficient than a chisel, crowbar or pick.

Hand Auger Costs.—Table II. gives the cost of some 6200 ft. of boring for which were used the hand augers shown in Figs. 3 and 4. These hand augers give practically the same efficiencies for depths of 15 to 20 ft., but for depths under 15 ft. the pipe auger is the faster. The rod auger, Fig. 2, consisting of 1 auger piece, 1 handle, 5 extension rods with 12 extra bolts 3/8 in. x 1 1/4 ins., cost $10.70. To this should be added cost of a couple of spanners and a handle for lifting.

The pipe auger, Fig. 3, consisting of 1 auger piece, 5 rods with couplings and bolts, 1 handle, 1 extra set of bolts and 2 spanners, together with 2 only 3/8-in. steel chains 4 ft. long, with one grab and one side hook attached to each, cost $15.

Wash Borings Costs.—Wash borings were made for the Intake Site and at the Falcon River Crossing with a "string of tools" which, though complete for the purpose, was not as elaborate as that necessary for deep drilling. The list of equipment with cost of same, given in Table III, may be used for reference when similar work is contemplated.

Table IV.—Wash Borings Average Cost Data

Depth of—	Totals	Average
Water	523.0	......
Muck	45.3	......
Clay	594.2	......
Sand	73.7	......
Gravel	31.7	27.6
Total length of casing, includes ice, water and material	1,267.9	47.0
Labor and food cost	$404.75	$15.00
Cost per foot below lake bottom		$0.541
Total cost per foot of casing in ice, water, material		$0.319

With this equipment the process of sinking the test holes was very simple and usually was as follows:

The derrick or tripod, consisting of three logs, was set up over the station where a hole was cut through the ice and the depth of water obtained by sounding. After this a suitable length of casing was put down; at the same time a hole for the pump suction was made and a fire was started in the heater to warm water, which facilitated the thawing of the tools. Then drill rods of the required length with chopping bit on lower end and hoisting water-swivel on upper end connected to derrick-rope and by hose to the force-pump, were put down inside the casing. The position of the bottom of the casing and the drill rods having been noted, the drill rods were churned up and down by means of rope over a block attached to tripod. At the same time water was forced down the centre of these rods to the outlet in chopping-bit and then up between the rods and the casing. The chopped material brought up by the water jet was noted by the leader in charge of the work. To sink the casing, chain tongs were attached and it was rotated. This rotation or turning of the casing to keep it free from sticking to the material drilled through, was the detail that added most to the speed of the work, not only in sinking the casing, but more especially in the pulling of the pipe. This method of sink-

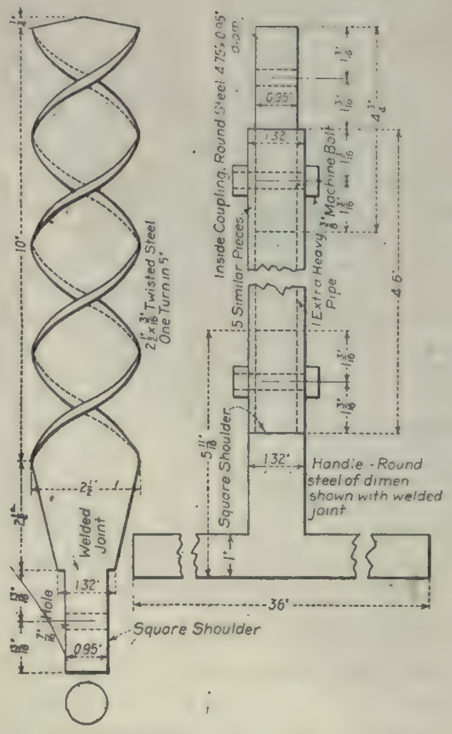
10'
2 1/2" x 3/16" Twisted Steel One Turn in 5"
2 1/2"
Welded Joint
Hole
1.32"
.095"
Square Shoulder
Inside Coupling, Round Steel 4.75; 0.95" diam
5 Similar Pieces
1 Extra Heavy Pipe
3/8" Machine Bolt
4'-6"
Square Shoulder
5 1/16"
1.32"
Handle - Round steel of dimen shown with welded joint
36"

Fig. 2—Hand operated rod auger used in making borings. Winnipeg Aqueduct.

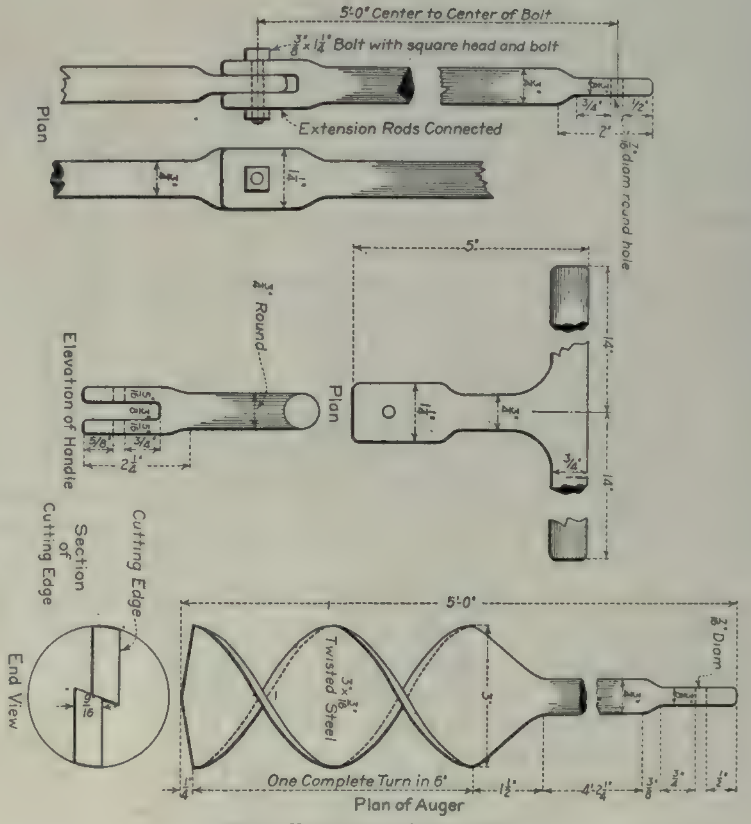

Fig. 3—Hand operated pipe auger.

ing the casing was not practical at all times and in such cases the drive weight was used to pound the casing down. After it had been used it was necessary to use the two jacks to draw the pipe as shown in Fig. 6. As the hole was sunk either by rotation of casing, or driving, constant watch was kept of the position of the bottom of the casing and the drill rods, together with careful note of the materials brought up by the water jet. For this particular piece of work at Indian Bay it was found advantageous to use a force of one leader or foreman, J. D. Logan, and four laborers.

The progress that can be made under winter conditions and the cost of same is given in Table IV. This gives total and average figures on the footage, the materials encountered and the labor and food costs and should be of use for information when similar work is contemplated. The force on this work usually consisted of 1 topographer at $3.95 and 3 laborers at $2.55 each, or 1 foreman at $2.80 and 4 laborers at $2.70. The work was done, with the exception of one day in December, between January 9 and February 27, 1914. The thickness of ice ranged fairly gradually from 1.46 ft. on January 9 to 2.60 on February 9. On that day the temperature dropped to —35 deg. and work was discontinued until February 24, when the temperature was plus 5 deg. at 7 a.m. and the thickness of ice was 3.17 ft.

Cost of Excavating and Grading for a Small Pumping Plant*

THE following cost data pertain to the excavation for a pumping plant which, owing to certain requirements of the company, was placed completely underground and covered with grass.

The hole excavated was 18 x 38 ft. in plan by 11½ ft. deep, with a sump hole in one corner of 1½ cubic yards. The top 18 inches of excavation was soft black loam, the next 2 ft. was clayey loam, and the rest of the excavation blue clay, requiring picking. The ground stood without bracing, and there was no trouble from water. Two good-sized boulders were removed from the hole.

Of the 292.5 cu. yds. excavated, 150 cu. yds. were hauled one mile over pavements and spread in place; 110 cu. yds. were hauled ½ mile over good roads and dumped without spreading. The balance, 32½ cu. yds., was back-filled.

Unfortunately, the foreman neglected to separate the team time hauling to each dump. The foreman sharpened the tools and assisted in various other ways with the labor. The cost data follow:

Item	Time and Rate		Amount	Unit Cost
Foreman	91 hrs.	44½ cents	$ 40.50	0.138 per cu. yd. excavated.
Labor excavating	532 hrs.	30 cents	159.60	0.545 per cu. yd. excavated
Teams and extra wagon	123 hrs.	75 cents	92.25	0.354 per cu. yd. hauled
Spreading on dump	45 hrs.	30 cents	13.50	0.090 per cu. yd. spread
Backfill	20 hrs.	30 cents	6.00	0.185 per cu. yd. backfill
Delivery of tools			6.90	0.023 per cu. yd. excavated

Members of the Montreal Builders' Exchange have made a trip through the Mount Royal tunnel of the C. N. R., and also inspected the various workshops, machinery, and crushing plant. Mr. Stewart, the assistant engineer, conducted the party over the works.

Designing Sewage Disposal Plants

IN reporting upon the design of the recently completed sewage disposal plant of Madison, Wis., John W. Alvord discussed certain principles which are of general application, but are not always sufficiently appreciated.

"It is particularly desirable," says Mr. Alvord, "with a sewage disposal works, to plan well for the future, as they are a type of municipal improvement which does not ordinarily receive enthusiastic attention or prompt enlargement as need for the same develops. The difficulties of financing and raising moneys for this particular municipal purpose are such that small additions to the plant are not easily made, and it is therefore the general conclusions that the advantages of an ample plant should be had for the present, and it should be built for a fairly reasonable time in the future, so that the public administrators will not be annoyed from time to time by the necessity of financing and increasing its works until some considerable expenditure becomes necessary. It seems to me, therefore, that it would not be out of place to now build a plant which would be capable of caring for the municipal wastes up to the year 1930, with such reasonable accuracy as they can at this time forecast."

Concerning the amount of sewage to be provided for, Mr. Alvord says: "In cities similar to Madison there is a tendency toward a gradual increase in water consumption due to the more extensive use of sanitary appliances and industrial uses. This increase in well metered cities is relatively slow, however, and I would suggest, as an estimate for it, about five gallons per capita in daily consumption per decade." In 1911 the amount per capita in Madison was 87½ gallons, and he estimates 105 gallons for 1920 and 110 gallons for 1930. As the sewage in Madison has been pumped for years, and the water supply also is provided by pumping, the ratio between the two was easily ascertained. It was found that since 1904 the ratio of sewage pumped to water pumped has varied from 1.06 to 1.28, the latest records in the report showing the sewage as being 119 per cent. of the water pumped. The additional 19 per cent. (with undoubtedly another 5 or 10 per cent.—possibly more—to balance the amount of the water supply not reaching the sewer) was probably almost entirely ground water leaking into the sewers. This is another illustration of what sewer engineers have in recent years known to be the case—that it is necessary to assume, in designing a sewerage system, that the amount of water to be provided for will ordinarily be greater than the water supply consumption. This, however, would probably be true in the majority of cities only where the sewers admitted ground water. In localities of the country where there is no ground water, or in case the sewers are made perfectly tight, the capacity of the system might probably be made approximately 25 per cent. less than where sewers which are not tight are laid in water-bearing ground.—The Municipal Journal.

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* By H. R. Ferriss (Victoria, B.C.) in Engineering and Contracting.

Large Reinforced Concrete Cribs Used for Welland Ship Canal Entrance[*]

Sections 38 x 110 Feet in Plan and 34 Feet High with Removable Bottoms are Built in Pontoons and Placed on Windrows of Broken Stone

By Rex J. Johnson, Assistant Engineer, Welland Ship Canal

REINFORCED CONCRETE cribs of unusual size, built in pontoons, floated into position, and placed upon windrows of broken stone, form the entrance walls for the Welland Ship Canal and its Ontario harbor. The total length of each crib is 110 ft. 4 ins., the width 38 ft., and depth 34 ft. The pontoon is built in knock-down form, so that when the crib is finished and the temporary wooden bottoms placed, it can be floated away. After floating the crib into position so that the longitudinal walls rest upon carefully placed rows of broken stone, the temporary bottoms are removed, and the inside filled with materials dredged from the channel. Careful analysis was made for the various possible conditions of pressure on the walls, and economy in the use of reinforcement attained by using timber bracing to decrease the bending moments due to temporary high pressures during construction.

The harbor which is now under construction at Port Weller forms the northern or Lake Ontario entrance to the canal, which is being built across the Niagara Peninsula. The harbor is being formed by building two parallel earth embankments from the original shore line for a distance of one mile and a half into the lake and dredging between them. These embankments will be protected by rough rip-rap for the greater portion of their length, but there are portions which are to be sustained on the inside with reinforced concrete cribs. These will provide vertical faces for the mooring of ships and, at the outer end where the embankments converge, will give a navigating channel for the full width between embankments. The total number of cribs to be built is fifty-three.

General Features of Construction

The method of construction is to build the cribs in a floating pontoon in Port Dalhousie harbor, some three miles distant from the site of their final location, and then to tow each one into position and sink it on a seat prepared by dredging. Each crib is divided into eighteen compartments or pockets by means of one longitudinal centre wall and eight cross walls. The outside end and longitudinal walls extend from top to bottom without an opening of any description, while the interior walls have a rectangular opening 8 ft. x 14 ft., the bottom of which is 12 ft. from the top of the crib. The purpose of these openings is to reduce the weight of the crib and, since they are near the top, to bring the centre of gravity lower down. Thus each pocket is separated from those adjoining for a depth of 22 ft., and it is intended that each shall be watertight. Watertightness is important, since the crib is required to float during construction and possibly for some considerable time after it is built.

A feature of the complete separation of the lower portion of the pockets is that, in the event of a leak developing in some part of the structure, only one or two pockets are flooded and the crib, instead of sinking, merely heels over somewhat from the vertical. The openings just mentioned in the interior walls do not extend down far enough to allow water to flow from a flooded pocket to a neighboring dry one except during sinking. Each pocket has a temporary timber floor or bottom which is wedged in place in such a way that, after the crib is sunk, the wedges are pulled out by chains attached to them and extending to the top of the crib. The patents for these bottoms are held by Messrs. J. L. Weller, engineer-in-charge, and F. E. Sterns, designing engineer, Welland Ship Canal.

Sinking and Filling Cribs

The sinking will be accomplished by pumping water into the pockets or by means of sea cocks in the outer walls. By carefully admitting the water the crib can be brought to within a few inches of the bottom and, when brought into exact position and line, a little more water admitted will bring it to rest in position. If, for any reason, it gets out of line while sinking the last few inches, some of the water can be pumped out and the crib will float again, thus allowing the error to be corrected. Each crib is provided with vertical projecting ribs at opposite ends and arranged in such a way that the crib will be keyed to the two adjoining ones.

The seat for each crib is dredged to a little below the required grade and then, to insure an even bottom, three windrows of broken stone are placed by means of spouts and levelled off, so that one windrow comes directly under each of the front, centre and rear longitudinal walls of the crib. After the crib is in its final position the temporary bottoms are removed. The pockets of the sunken crib are to be filled by dredges with selected excavation (not rock) from the harbor. The reasons for constructing a crib with bottomless pockets are for economy, since the timber bottoms can be used over and over again, and for the purpose of allowing the crib filling to rest upon the sea bottom instead of on the bottom of the crib as is ordinarily the case. This tends to prevent settlement and prevents undue strains upon the crib and secures an even bearing on the foundation, accomplished by means of the rows of stone under the longitudinal walls.

Cribs Built in Pontoons

Each crib is built in a pontoon, which is nothing more than a rectangular box with open top and having for its inside dimensions those of the outside of the crib. The depth of the pontoon is about 9 ft., and it is built in knock-down form so that, when the crib is finished and the temporary wooden bottoms placed, it can be taken off. This is done by unscrewing the sides and ends and allowing them to float away, and allowing bottom, which has been previously ballasted, to sink away. Inside the floating pontoon are built the forms for the lower portions of the walls, the sides of the pontoon acting as a part of the form work. As the walls rise, the pontoon sinks deeper and deeper and finally disappears below the surface owing to the continually increasing weight sustained by it, the sides of the crib above the pontoon serving to keep the water out. The temporary bottoms are placed after the form work in the pockets has been removed.

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[*] Copious abstract of an article in The Engineering Record.

A watertight joint is made between the bottoms and the concrete ledge upon which it rests by placing between them a rope made of jute yarn covered with canvas, which is tightly squeezed down by the wedges that serve to hold the bottom in place. On the construction work which has already been accomplished the contractors have poured the concrete in lifts of about 3 ft., alternately placing the horizontal reinforcing steel in position for each lift and pouring concrete. The vertical steel extending from top to bottom without a break must be placed before any concrete is poured.

Conditions Governing Design

The design takes into account three different conditions of loading for the walls: (1) The exterior water loads on the floating crib; (2) the exterior and interior water loads on the sinking crib, and (3) the interior fill loads on the submerged crib when it is in its final position and during filling.

First, the exterior water load on the floating crib will be considered. The position of the water line on the completed crib is determined by considering its displacement, and then it is assumed that one or more of the pockets may become partially or wholly flooded to such an extent that a maximum heeling over is produced which causes the water line to rise on one side a distance of 5 ft. The maximum head of water sustained by any one wall is found to be 18 ft. for this condition, and the pressure diagram can be drawn. This load may occur on the interior walls as well as on the exterior, since any one pocket may become flooded.

Next, consider the water loads on the crib as it sinks. When the water is admitted to the crib it starts to sink, thus causing the water line on the outside to rise. This reaches the top of the crib when the water on the inside is 14 ft. from the top and the resulting pressure diagrams are as shown. The interior walls, as well as the exterior, are designed to sustain this load, since any one of the pockets may become wholly flooded before the crib is ready to sink.

Finally, the pressures set up on the walls by the fill loads will be considered. When in actual service the top of the crib is to come at mean lake level and on top of the outside longitudinal wall a 7-ft. retaining wall will be constructed to support the back filling. This fill is for the purpose of bringing the pier up to final grade and, of course, acts as a superimposed load on the front longitudinal wall of the crib. We then have the condition of a dry fill 7 ft. deep, and under this a thoroughly saturated, or, strictly speaking in this case, a submerged fill contained in a pocket or box-like structure having the walls comparatively close together, and hence a condition somewhat similar to that in the bins of a grain elevator. The pressures on the front wall due to the fill are greater than for the interior and rear walls, because the filling operation will be regulated so that no one pocket is filled to the top before the adjacent ones are at least half filled. This point is taken up again later.

Pressure Diagrams

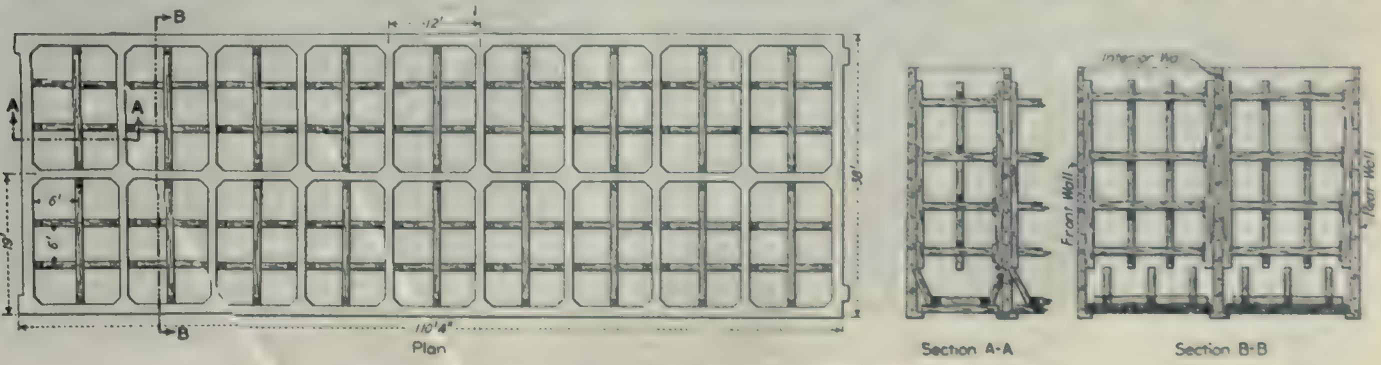
The pressure lines resulting from the foregoing conditions are shown by the accompanying figures. The following assumptions are made with regard to the fill: (1) The fill above the water is dry, weighs 110 lb. per cubic foot and has a slope of repose of 1½:1; and (2) the fill below the water is thoroughly saturated and has a slope of repose of 3:1. Its weight when dry is 110 lbs. per cubic foot, if free from voids it would be 153 lbs., and therefore when immersed it weighs 110 — (62.5 × 110/153) = 110 — 45 = 65 lbs. per cubic foot.

The water line, i.e., at the top of the crib, there is a horizontal pressure due to 7 ft. of dry fill having a slope of repose of 1½:1. Below the water line the pressures on the walls are due to a submerged fill with a slope of repose of 3:1, and they are complicated somewhat by the proximity of neighboring walls. The effect of nearby walls on earth pressures is very little understood. It is probable that the total pressure on any one wall is less than it is for an ordinary retaining wall sustaining the same material. In the calculation for the crib no reduction has been made on account of these walls.

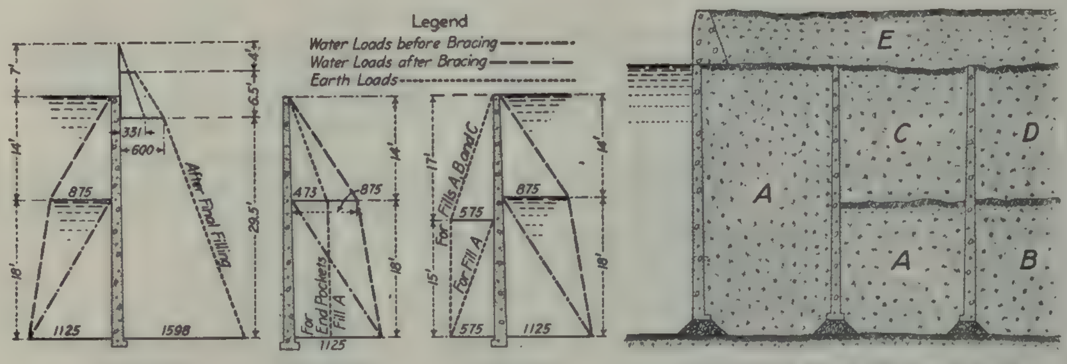
The diagram for the earth load on the front wall is calculated by Coulomb's formula for earth pressures for two conditions: (1) When the harbor is at high water and the depth of dry fill is only 4 ft.; and (2) when the harbor is at low water, and the depth of dry fill is 10.5 ft. The resulting pressures are shown by the accompanying diagrams.

Pressures on Interior Walls

The sectional elevation drawn with the diagrams herewith shows the order in which the pockets are to be filled with earth. The two fills marked A are to be made simultaneously, then B, then two fills C simultaneously, then D and E in order. Thus we get an earth load on the centre longitudinal wall which is partially balanced over its lower portion, and on the rear wall we get an earth load over the lower half and later over its whole height, but with the lower portion reduced by the fill B. By adopting this method of filling a considerable saving can be made in the reinforcing steel for the walls. The earth pressures on the interior cross walls are the same as for those on the centre longitudinal wall. The earth load diagram shown for the interior walls occurs only in the end pockets. In all the others the load is less because the openings in the interior walls allow the filling to flow through from



General dimensions of crib and pockets, and details of method of using timber bracing.



Front Wall interior Wall Rear Wall Section Showing Method of Placing Earth Fill

Diagrams showing conditions of earth fill and water pressure.

one pocket to another before any one of them is filled to the top.

A comparative study of the combined pressure diagram reveals the large loads carried by the walls due to the water pressure when the crib is sinking. These act for a comparatively short interval of time, and it seemed that if some scheme could be devised for bracing the walls while the crib is sinking that a very considerable saving in reinforcing steel could be effected.

Use of Timber Bracing

The scheme proposed is to use timber bracing wedged into the pockets. It is placed before admitting water and removed before the pockets are filled with earth. The bracing is arranged in such a way that the spans over which the water loads act are reduced to 6 ft., and hence the bending moment and therefore the steel necessary, are considerably reduced. The drawing shows the proposed arrangement of the bracing. It is seen that without this bracing the spans of the front, rear and centre longitudinal walls are 12 ft., and of the end and cross walls 18 ft. When it is remembered that the bending moment varies directly as the product of the square of the span and the load per unit of span, the effect of the bracing in reducing the quantity of reinforcing steel is apparent.

The walls are designed as slabs, using the load diagrams to give values of loads per foot. For permanent loads the stresses for steel and concrete and the coefficients for bending moments are those recommended by the Joint Committee on Reinforced Concrete; but for temporary loads, or loads which act only for a short time, such as in the sinking operation, the stress in the steel is run up as high as 25,000 lbs. per square inch. Longitudinal stiffness is given to the crib by placing reinforcing rods near the top of longitudinal walls for their full length. The reinforcing steel is in the form of plain round rods, and the spacing has been confined to multiples of 6 ins. as some little aid in standardization and simplicity in construction. For the same reason the size of rods is confined to ¾ and ⅞-in. diameters. Each crib requires 934 cu. yds. of concrete and 112,000 lbs. of steel.

The work is being done under the direction of the Department of Railways and Canals. Mr. J. L. Weller is the Engineer-in-Charge.

Forks, spades, or other suitable instruments should be used for puddling wet concrete after it has been deposited in the forms. These implements should be small enough to enter well into the space between and around the reinforcing steel.

Railroad Construction and Bridge Work in the Province of Quebec

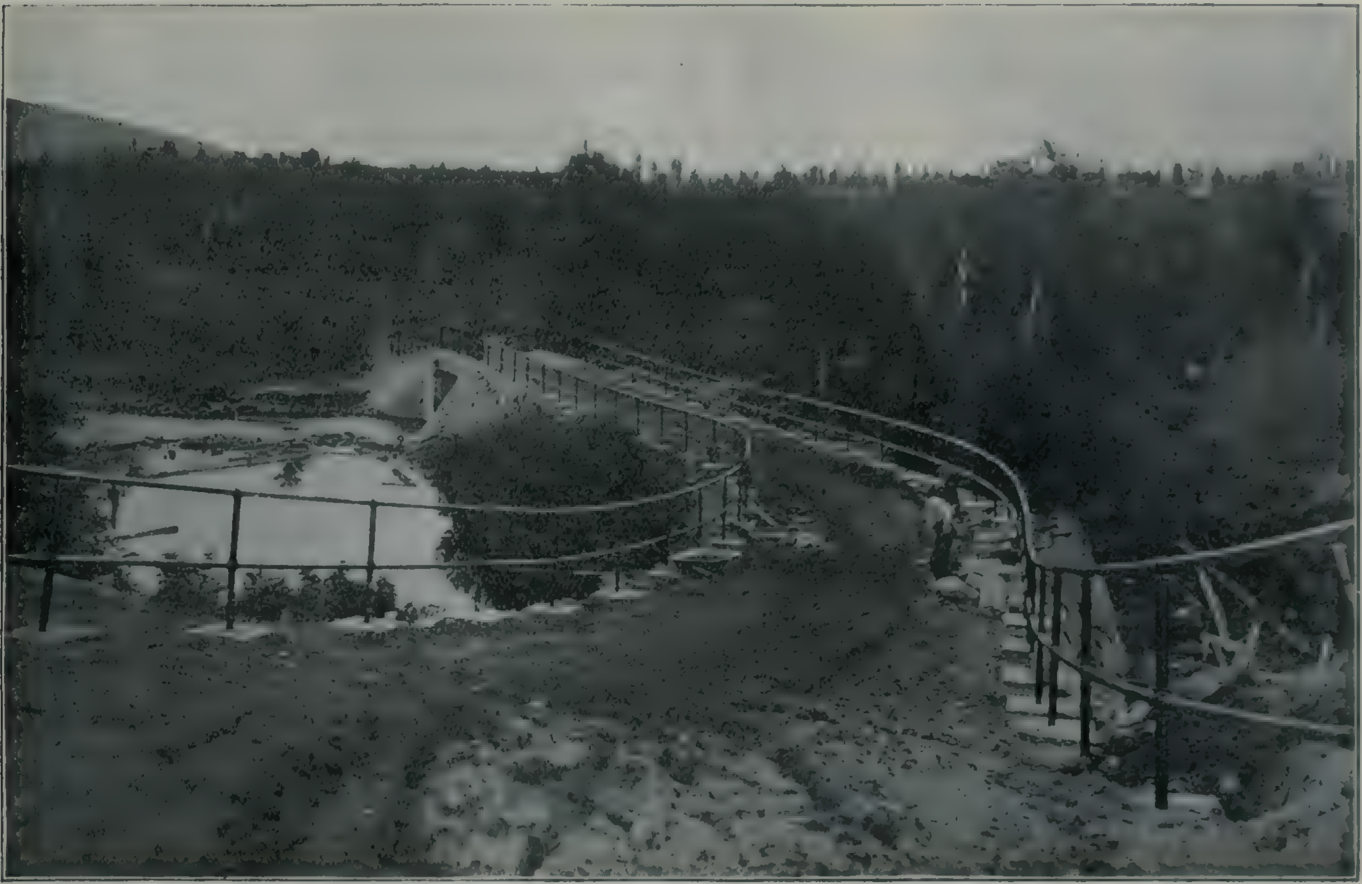
THE 1914 general report of the Minister of Public Works and Labor for the Province of Quebec contains illuminating details of construction work. One of the features of interest is a statement concerning iron bridges built by municipalities and subsidized by the Government of the Province of Quebec from 1908 to June 30th, 1914. Three were erected in the county of Argenteuil; five in Arthabaska; thirteen in Bagot; five in Beauce; two in Beauharnois; ten in Bellechasse; three in Bonaventure; three in Berthier; ten in Brome; five in Champlain; two in Chambly; one in Charlevoix; three in Chateauguay; three in Chicoutimi; seven in Compton; two in Dorchester; five in Two Mountains; five in Drummond; one in Gaspe; five in Huntingdon; four in Iberville; eight in Joliette; five in Kamouraska; two in Labelle; thirteen in Lake St. John; four in Laprairie; five in L'Assomption; one in Laval; one in Levis; two in L'Islet; eight in Lotbiniere; two in Maskinonge; one in Matane; nine in Megantic; one in Montcalm; four in Montmagny; six in Montmorency; two in Missisquoi; one in Napierville; five in Nicolet; two in Ottawa; ten in Portneuf; one in Pontiac; four in Quebec; six in Richelieu; two in Richmond; two in Rimouski; seven in Rouville; two in St. Hyacinthe; one in Saguenay; three in St. Maurice; seven in Shefford; five in Soulanges; three in Sherbrooke; four in Stanstead; two in Terrebonne; two in Three Rivers; two in Vaudreuil; seven in Vercheres; one in Wolfe, and nine in Yamaska.

The list it will be seen is quite a formidable one, and it is supplemented by a further list of nearly sixty bridges under construction at the time of the preparation of the report.

A number of the more noteworthy bridges of recent erection are illustrated in this issue.

An item of interest is the report of Mr. Louis A. Vallee, Engineer and Director of Railways. A table showing the length of railways built, in operation, or ready to be opened to traffic in the Province of Quebec on June 30th, 1914, gives a total of 4,339 miles. This is inclusive of 230 miles of electric railway.

Proportioning by sieve analysis is the most exact and effective method of studying the character of the aggregate and for calculating the effect of various mixtures. In this method the available materials, excluding the cement, are separated into various sizes by means of a series of screens.



Bridge over Riviere Aux-Pins, Saint-Gabriel-West, Quebec County, Quebec.—One Span of 28 feet.

Bridge over Chaudiere river at Saint-Maxime-de-Scott, Dorchester County, Quebec.—Three Spans 1-225', 1-214'. 1-139 feet.

The Engineer, the Contractor, and the Specification

Considerations which make for Improved Efficiency in Service

THE engineer or architect is able to plan great structures and large engineering schemes; but when it comes to the erection of these structures or the methods adopted in carrying out these engineering feats to successful conclusion, this work usually devolves upon the contractor.

The contractor occupies a peculiar position in that, to be successful, he has to be possessed of a temperament and faculties not required in the average profession. I mean that the successful contractor meets and has to contend with more obstacles in his work than fall to the lot of the average business man or merchant; and in addition he has to be able to manage and direct his office affairs and the work of his employees in such a way that for every dollar spent on his work he hopes to receive more than one hundred cents in return.

The engineer has a great many advantages in planning a great enterprise over those enjoyed by the contractor. Usually he is not limited in the time taken in drawing his plans and specifications, and has ample opportunity to investigate all conditions and make researches prior to the time when bids are called for; but the time allotted to the contractor for preparation of this bid is usually very short, and often a sufficient period is not allowed him for investigation of conditions, source of supply of labor and material, and other important considerations which go to make up the bids prior to the opening of the same.

It has been said, and truthfully so, that a successful contractor must have three qualifications—first, Faith; second, Hope; and third, Nerve; and of these three virtues (if they may be so termed), it seems to me the last is the most important.

First, contractors as a general rule know the men at the head of all large engineering schemes upon which they bid, and have faith in their judgment, and accept without question their plans and specifications as being correct and the result of months and probably years of study, and rely in a great measure upon their judgment.

Second, they hope, in event of securing a contract, to be favored with such conditions when the work is under way as will enable them to make money legitimately, because you will find that the average contractor doing business to-day is honest, and he takes a certain amount of pride in his work (although in this, as in all cases, there are exceptions to the general rule); and he hopes, when certain conditions and questions arise during the progress of the work, and the matter under discussion is put up to the Chief Engineer or other official in authority, that he will be big and broad enough to look at the situation from the contractor's standpoint, as well as from the viewpoint of the municipality or corporation by whom he is employed.

Third, to undertake large contract work requires considerable nerve, because usually, if conditions are favorable and the prices at which the contract has been secured are reasonable, and the specifications liberally construed by fair-minded engineers, the contractor sometimes makes money; but ofttimes when unforeseen conditions arise during the progress of the work, materials and labor advance, extremely rigid and arbitrary interpretations are given to the specifications, impractical and unreasonable inspectors placed on the work, and various other obstructions put in the contractor's way (sometimes by those directly interested in the contract, and at other times by disinterested parties), it requires considerable nerve on the part of any man to continue the business of contracting in order to make a living.

Practically all recent works of great magnitude have been let by contract, with one exception, that being the Panama Canal, which is being built by the Government, under the supervision of army engineers who had practically an unlimited amount of money at their disposal, and who were not hindered in any way in the expenditure thereof, their motto being, "Build the Canal, build it well, and at any cost."

Great works like the increased water supply for New York City, the New York Barge Canal, the reclaiming of millions of acres of land in the West, the improvement of our rivers and harbors, and even down to our own local improvements, such as the water supply, the building of our sewers, paving of the streets, building of the docks, extensions of parks, improvement in terminal facilities, improvement of state highway system, erection of municipal buildings, etc., have all been let by contract, for the reason, no doubt, that those in authority recognize that where possible it is much better to have the work done by this method than under the day labor system.

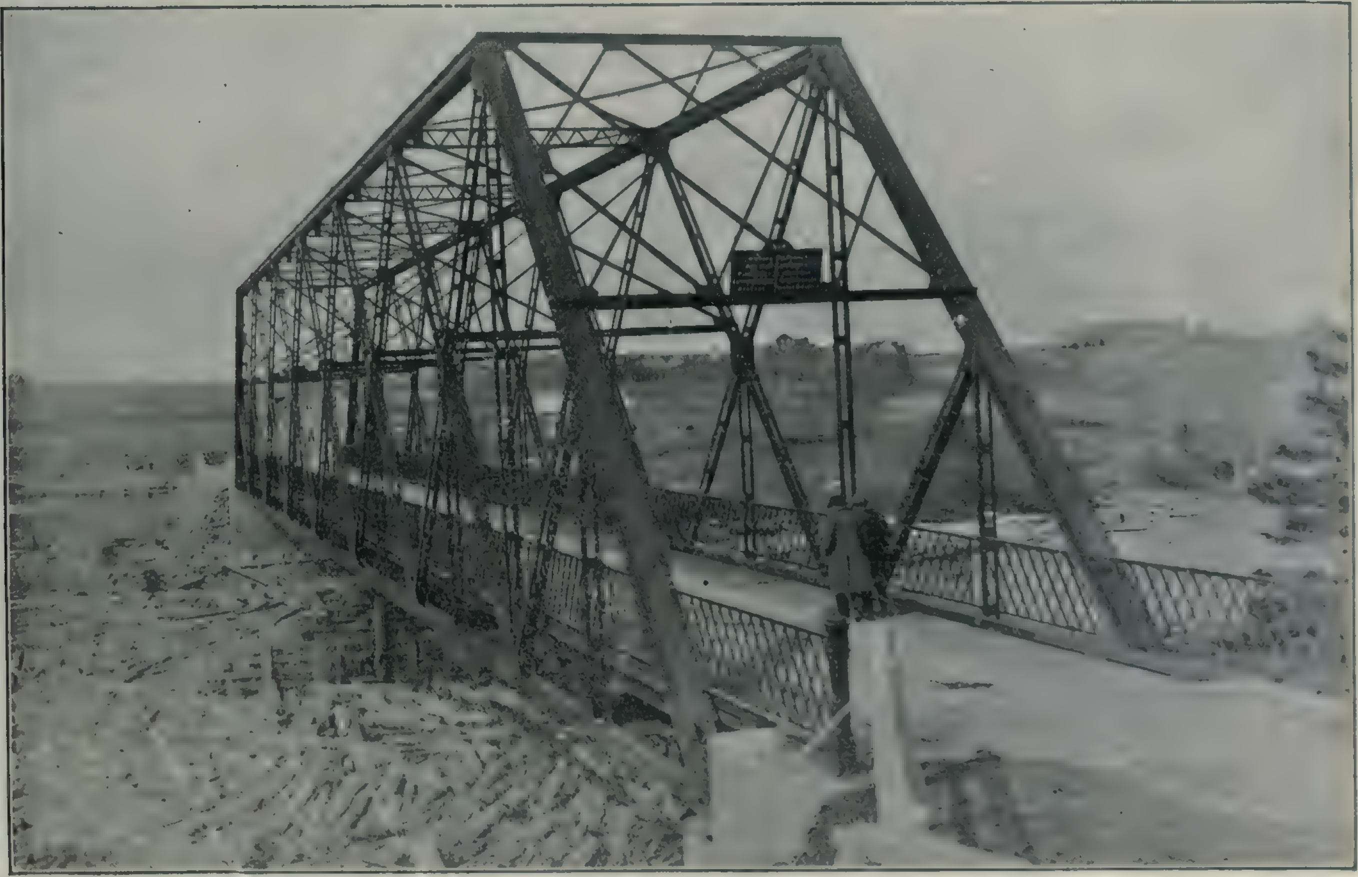
The work is done as well under the contract system as if it is performed by day work, and ofttimes better, because on day labor work done by a State, municipality, or corporation, usually there are no rigid specifications in effect, and practically no inspections (except when the engineer happens to be on the work); and many things are done which would not be tolerated for a moment if the work was being done under contract; furthermore, the engineer on contract work has less worry (this being shifted to the contractor's shoulders); and the last but not least reason is that it is almost universally conceded that work done by contract is done far cheaper than if performed by the day labor method.

A prominent engineer once told the writer that "specifications were only made for rogues and thieves, that honest men did not need any specifications." He meant this, however, to be interpreted in a broad way.

I do not fully agree with him in his statement, because I believe that short specifications clearly written and impartially enforced are a benefit to both the municipality or corporation and the contractor.

The clauses in a set of specifications as written by the average engineer are not always clear and intelligible to the average contractor; and anyone who engages in contracting work now, if he wants to be "up-to-date" should take a course in law also, so as to be able to reason out the intent of some engineers who write specifications, because some specifications of to-day, if literally construed as written, could place an average contractor in receivers' hands in a short time,

Bridge over Moose River, Saint Andre-d'Acton, Bagot County, Quebec.—Span, 75 feet.



Bridge over Metis River at Price, Matane County, Quebec.—Span, 250 feet.

unless he had an unlimited amount of money at his disposal.

Take the usual set of specifications as issued to-day for public work to reputable attorneys, and ask them to give you an unbiased opinion of its contents, and ninety-nine out of one hundred will tell you that you would be foolish to sign a contract with such clauses incorporated therein, because it is so written to provide all the safeguards possible for the municipality and to place the responsibility for everything that may happen, even including the acts of Providence, upon the contractor.

In other words they bind the contractor hand, foot, body, and soul, because some specifications have almost every possibility and condition between the heaven and earth, and even into the depths of the same, covered by a clause which they can point out, which covers the disputed point when questions arise; but contractors must live, and some, in their eagerness to secure work, would sign any contract and specification no matter how definite or unreasonable it was.

To my way of thinking, it is a mistake to make specifications too lengthy; but some engineers seem to think that it is absolutely necessary to have a large volume of directions written for the contractors' guidance, even though the job is a very small one. They write so much, in fact, that their requirements overlap; that is, the clauses contradict themselves; and in one part of the book you will find certain clauses, and by carefully reading subsequent paragraphs, you will be left in doubt as to the real intent and meaning of the one who wrote the specifications and as to how they will be enforced.

If the specifications were short and clear—that is, expressed in plain every-day language, which neither the engineer nor the contractor could take advantage of (in other words, the avoidance of double meaning clauses)—many of the disputes which now constantly arise would be prevented.

When a dispute does arise on work, the interpretation of the particular clause in question is usually put up to the engineer in charge of that particular section or piece of work for decision; and this is where a young engineer should be given some authority.

If enough confidence is placed in a man to select him as the pilot of a particular piece of work, enough trust and authority should be placed in him to construe disputed clauses liberally when the occasion arises; and he should be given the right to settle minor questions that arise, and not be troubling his chief with every little matter of detail; and only in case that he and the contractor cannot agree should the question be carried to the Chief Engineer.

In ninety-nine cases out of one hundred, minor disputes such as arise on contract work can be reasonably and promptly settled if all parties will meet with a feeling of friendliness and confidence; but the average young engineer, knowing that he has the book of specifications to rely upon, and that they are his doctrine, and the further fact that he is in authority in so far as that particular piece of work is concerned, ofttimes looks at the clauses under discussion from a very narrow point of view; and if an appeal should be taken from his decision and carried to the Chief Engineer, ofttimes he considers it a personal reflection upon his professional ability; and although the decision of the Chief Engineer may sustain him, there is always a feeling of coolness between him and the contractor.

Whereas, on the other hand, if the decision of the Chief Engineer should be adverse to the younger engineer and contrary to his views already reported to his chief and in favor of the contractor, usually he feels that a personal insult has been inflicted on him and his professional ability questioned; and I have heard of instances where the engineer resolved to "get even"; and, holding the master key, he sometimes is in a position to take advantage of the other.

Engineers and contractors gain their experience from years of hard work. Textbooks do not contain all the rudiments of any profession; these are secured by personal efforts, hard knocks, and practical experience; and a young engineer at the completion of his required course in a university is not as fully qualified to pass on all questions as one who has had years of experience, although the technical education of the latter may be somewhat limited when compared with that of the former.

Contractors usually get their experience by hard work, and ofttimes at great expense; and some reliance should be put in their judgment also. In other words, some little credit should be given a contractor who has had years of experience, for knowing a little of the work he undertakes and the best method of conducting it, because, as before stated, a contractor, to be successful, must adapt himself to all conditions; must have such a personality as will enable him to please and work with the engineers, and at the same time look out for himself from a financial point of view.

It is sufficient to say, in conclusion, that an engineer should rely somewhat on the contractor, "give him some credit for his experience, etc.;" and the same confidence should be put by the contractor in the engineer; and if they are of such temperament that they can work in harmony, disputes will not arise. When they do, they can be quickly adjusted and have no ill feeling at their conclusion, and success will be the result of their efforts.—Engineering News.

A continuous mixer may be tested by measuring out a batch of concrete in the desired proportions and running it through the machine to see whether or not it feeds correctly. If not mixed properly it should be run through again or mixed by hand. Several tests shoud be made each day to see that the cement delivered is constant in amount.

In placing concrete in floor slabs, girders and beams, the work should, if possible, be carried along in a straight line from the section of the builidng which is being concreted. Unless adjoining masses of concrete of different depths, like adjacent girders and slabs, have the puddling or ramming operation carried down as thoroughly through one as the other, initial setting cracks are likely to form between the masses of different depths.

At a recent meeting of the Chamber of Commerce in Montreal, Mr. Leon Lorrain said that Canada's fire loss was relatively the biggest in the world. In five cities of Canada, with a total population of 957,372, the speaker said, the loss per capita for the year 1912 was $2.88, as against $2.55 in 300 American cities, 54 cents in cities of England, 84 cents in France, 20 cents in Germany, 30 cents in Austria, and 90 cents in Italy. In 1914 the fire loss in Canada was $3.15 a head.

Quantity System of Estimating—American and English Methods Compared

By Albert G. Duke*

It would seem to any contractor on this side of the Atlantic that the London system of quantity surveying required too much preliminary work, especially in these days when the contractor is left so little time to prepare an estimate; and the fine detail is not required or worth the time spent upon it. We have no recognized method of taking off quantities in this country, and until the profession is established, it must be left to each contractor to develop his own method.

It is the writer's intention to explain and show briefly a method of taking off quantities and estimating, so that the advantage of the method now advocated may be seen by comparing the two systems. This system of "taking off" is the one used by the Aberthaw Construction Company, of Boston, Mass. It has been used by them for the past seven years, and has proved entirely satisfactory in every way, being equally applicable to large and small works of any character.

The reader will notice at a glance that the chief labor-saving item is the fact that all the work appears on one set of sheets, whereas the London system requires three sets of records—viz., the "Dimensions," the "Abstract" and the "Bill." In the Aberthaw method, it is important to notice the systematic order of setting down the dimensions, and that each column is issued for a specific purpose, so that when it is necessary to refer to the dimensions later, or variations are to be made, the items can be easily identified.

The first column on the left is for the description and location of the work, also for any notes useful for further reference. The third is for length, fourth for breadth, the fifth is for height, while the second is used for setting down the number of floors, footings, or other items by which the measurements should be multiplied. As the figures are connected by multiplication signs, the clerk who extends them has a simple arithmetical expression to extend, with very little chance for any misunderstanding. The remaining columns are for extensions, unit prices, and total money, respectively. The right use of these columns is very important, and if it is faithfully followed out it will be perfectly easy for any person to refer and identify a dimension at any time after it has been made.

One man should scale the whole of the building, another extend the dimensions, and the same one who scales should check the extensions after he has taken off all dimensions. This makes two distinct operations and leaves the estimator's mind clear for scaling. Each trade or operation is taken in turn, taking every item throughout the building before proceeding with the next operation. Assuming a brick building, the estimator would commence with the brickwork foundations and continue until all work taken care of by the Bricklayer is taken, before commencing with any other trade. The same applies to the Earthwork—clearing site, digging, backfill, any pumping, sheeting, etc., would be entered under this reading. All trades to be treated in the same way.

It is essential, in order to avoid omissions or errors, to follow a regular order of "taking off" the work, and the main items should always be taken first. For instance, assuming a certain contractor's chief work is brickwork, it would be as well always on every estimate to commence with this item, then follow with concrete, excavation, drains, windows, carpentry, doors, roofing, painting, glazing, miscellaneous iron work, etc., etc. In general the work should be "taken off" in the same order as the job is constructed. The method of booking a dimension, cubic, superficial, lineal, or number should be followed according to the prevailing method of pricing or purchasing material.

The letters "Ddt" after a dimension denote that the item is to be deducted, the extension being put a little to the left so that it may readily be seen. It will be noticed that fractions are used for parts of a foot because the dimension is easily understood, and there is not the chance of mistaking the position of a decimal point that so frequently occurs when decimals are used.

All quantities should be taken off first, and then the unit prices set down in the column provided. No extensions should be made until this has been done.

As to whether or not dirt in sand is harmful depends upon the character of the dirt. The kind of impurity is really of more importance than the quantity. The presence of a small amount of clay in sand does not as a rule weaken or injure mortars or concretes, but it is generally considered that the presence of loam or dirt is objectionable.

ESTIMATE FOR ONE-ROOM BRICK BUILDING, MARCH 15, 1915

Concrete to foundations	2 ×	(14⅓ + 10)	× 1⅔ ×	1	81	= 3cu yds.	6.00	18
6in. concrete paving, with 1in. granolithic finish		12	× 10		120	120sq.ft.	.15	18
Brickwork in cement mortar	2 ×	(13⅓ + 10)	× ⅔ ×	14	436	436		
Windows	4 ×	3	× ⅔ ×	4	ddt. 32	46 ddt.		
Door		3	× ⅔ ×	7	ddt. 14	390 = 390cu.ft.	.50	195
Clear site and grade for paving								5
Dig trench, wheel, and deposit	2 ×	(13⅓ + 10)	× 3 ×	5	700	= 26cu.yds.	1.25	33
Backfill		46	× 2 ×	4	368	= 14cu.yds.	.50	7
Mason work—								
8in. by 5in. stone window sills	4 ×	4 f. l.				16 f. l.	1.00	16
10in. by 6in. stone threshold to door		4 f. l.				4 f. l.	1.50	6
Carpenter work—								
Boxed frames, 3ft. by 4ft., double hung sash and glazing with clear sheet glass.						:: 4	5.00	20
Labour, setting, and jointing						:: 4	2.00	8
Trim						:: 4	2.00	8
2in. door and frame (4 panel), and trim, 3ft. 6in. by 7ft. 6in.						:: 1	15.00	15
Labour, setting, and hanging						:: 1	5.00	5
Hardware to windows and doors								10
1in. by 6in. baseboard	2 ×	(10 + 12)				44 f. l.	.20	9
				f. l.	b. f.			
Rafters, 8in. by 2in.	13 ×	14	=	182	243	= 390 say 400 b. f.	45.00	18
Plates and sundries					150			
1in. tongued & grooved roof boarding		16′	× 14′		224	= 2¼sqs.	4.50	10
Trim to eaves	2 ×	(16 + 14)				60 f. l.	.20	12
Plastering—								
Walls, three-coat work	2 ×	(10 + 12)	× 9		396	396		
Windows	4 ×	3	× 4		ddt. 48	69 ddt.		
Door		3	× 7		ddt. 21	327 = 36⅓sq.yds.	1.00	36
Lath and plaster to underside of ceiling		12	× 10		120	= 13⅓sq.yds.	1.25	17
Painting, three-coat work—								
Door	2 ×	4	× 8		64	sq ft.		
Windows	2 × 4 ×	3½	× 4½		126	430 = 48sq.yds.	.30	15
Eaves		60	× 4		240			
Cold-water paint walls and ceiling (take plastering measurements)		36⅓	+ 13⅓	sq yd.		50sq yds.	.05	3
Ready roofing		16	× 14		224	= 2¼ sqs.	4.00	9
						Total net cost		$493
						Contractor's profit	15 %	74
						Contingencies and sundries		50
						Total		$617

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* Of the Aberthaw Construction Co., Boston.

Better Buildings: An Architect's Advice to Prospective Builders*

IT is the intent of the writer to give in this article a few words of practical advice to those contemplating building. We have often observed structures which appeared substantial and enduring when first erected to have shown in a few years signs of decay and we stop to determine the reason. Cracks in the walls have appeared caused by unequal settlement of the foundations, defective mortar has crumbled and fallen out of the joints. Then again we find the so-called galvanized iron which has been used for turrets, wall coping, buttress caps and what not, going to pieces. We find a piece of a substantial brick wall omitted to give space for a tin name plate. Would it not have been preferable to have omitted much of this tin ornamentation, often badly designed, and applied this expense to making the essential portions, such as wall coping and buttress caps of an enduring material?

The tendency of the times is toward the construction of buildings for today only and unfortunately this seems to apply more to churches than any other building, which on the contrary, should be the most enduring of structures. The most regrettable feature of this matter is that the same amount of money that is expended on these buildings would build good, permanent and enduring structures.

Get the Right Architect

The first and the most vital step in any building operation is the selection of an architect, upon it depending much of the ultimate success or failure of the project. The architect should be selected on the merits of his completed work, and upon his honesty and integrity. The works and the character of the man who is commissioned to plan and supervise the construction of a building should be thoroughly investigated before he is employed.

Competitions as they are usually conducted are not conducive to the best results. The distinction must here be made between a draughtsman and an architect. A good draughtsman would be able to produce a very fine drawing whereas the executed work is very apt to be unsatisfactory.

Another point to be considered where open competition is resorted to, even where only good architects are competing is that men under these conditions will not thoroughly study and investigate the problem, consequently schemes will be presented that have been prepared in a hurried manner, the first that comes to mind. In order to be certain to obtain the best results, viewed from every phase, a problem in building must have the most careful study and investigation. This requires much thought, labor and expense, which men in competition cannot afford on account of the uncertainty of the result, and is also the principal reason for the difference in fees charged by different men as this same thought and labor applies not only to the general scheme, but to every detail of the building. Any good architect is able to present a scheme in a very short time, usually, in the opinion of the layman, a good enough solution. If the result, however, is to be correct and certain, every possibility must be considered and good judgment exercised in the selection of what is best.

After an architect has been selected it is important, if the best results are to be obtained, that his advice be heeded and his drawings and directions faithfully adhered to. Absolute confidence must exist on the part of the owner toward the architect, both as to his honesty and ability, as many matters may arise during the progress of the work that will test this confidence to the limit.

It often occurs that an architect is commissioned to prepare only the drawings and specifications of a building, leaving the supervision to someone else; I have not in my experience found this satisfactory. Architects are held to blame for defective work on these buildings by the public, who do not know the conditions, and even sometimes by the owners themselves.

Where several sites are under consideration it will be found advisable to consult an architect on the selection, as an experienced man will often be able to offer some valuable advice in this connection. When locating a new building on a site, future building and additions to the present building should be most carefully considered, this is especially true in the case of institutions and in large or rapidly growing parishes.

Where a maximum amount that a building is to cost must be named, as is usually the case, this amount should be given the architect; the concientious man will endeavor to remain within this limit. Owing to the variation in the proposals from contractors and in local conditions which are often difficult to foresee, the estimate on the cost of a proposed building often resolves itself more into a matter of judgment than of figures. The cost of a building cannot be definitely known until complete drawings and specifications are prepared and proposals received. However, by a careful calculation of the labor and material and the exercising of experienced judgment and by comparison with completed buildings an estimate can be given sufficiently accurate for practical purposes.

The style of architecture should be left largely to the architect. Permanent existing buildings belonging to the same group or prominent buildings in the near vicinity will affect the decision. The cost of the building and the personal preference of the owner will frequently have much bearing on this matter. With the many good styles of architecture in existence, it is to be regretted that there is so much sameness in church building. What a beautiful interior could be produced in the Roman Basilica style like St. Paul's, Rome, or exterior in the Romanesque like St. Peter's, Rome, the English Gothic, or the Byzantine, any of which are good if executed faithfully. In any case it is best by far to build a substantial permanent structure of good material, adhering strictly to the proportions and details in a style that can be built for the appropriated amount in preference to the reverse in another style of architecture.

It would be preferable if more time were allotted than is customary to the preliminary sketches and also to working drawings and specifications of the building. Ample time should also be allowed for the preparation and receiving of proposals. Before awarding the various contracts the work and character of the men under consideration should be carefully investigated and only reliable and conscientious men employed. All contracts should be written on blanks known as the "uniform contract" and all contractors should give bond for the amount of the contract. All bonds should remain in effect for two months after the final completion and acceptance of the work. Drawings and specifications should have the most thorough study and inspection before letting the contract, but in case any additions or alterations, even of the most minor nature are found necessary, such alteration or addition should be made upon written order of the architect, strictly according to contract before work on such addition or alteration is commenced. Many lawsuits in connection with building operations would be avoided if all matters pertaining thereto were placed in writing in proper form.

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* By A. F. Moratz, in The Ohio Architect, Engineer and Builder.

Cost will largely determine the selection of materials; after that permanency should be the determining factor. The color and kinds of material, their size and disposition should be left to the discretion of the architect, and should conform to the style of architecture It is far preferable to omit ornamentation, unless it can be executed in permanent material in good taste and correct style In the selection of material only those having had a thorough test in the location in which they are to be used should be considered. Medium hard burned brick of regular form, and concrete reinforced where required, are good materials for structural parts of footings and walls. Close grained stone, terra cotta, marble or granite may be used for exterior walls, wholly or in part, where funds permit. Hollow tile is a good material for the structural part of floors, and for walls where the lateral strain is not too severe. Stucco for exterior walls on hollow tile makes a good construction where properly handled. Where competent and thorough inspection is not possible, stucco should be avoided as much as possible as should also extensive operations in concrete construction. Mortar being under the most favorable conditions the weakest part of the wall should be of the best quality and most carefully inspected. Avoid slow setting ingredients in mortar; Portland cement, one part to sand two parts, makes good mortar. It would be impossible for me to lay too much stress on the importance of good mortar; if the mortar is defective, the walls and the building are most seriously defective. Wall copings where required should be carefully inspected and made of the most permanent material. If water is permitted to penetrate a wall through wall coping or otherwise, it will soon disintegrate. It would often be possible to construct much of the structural parts of a building of masonry instead of wood without any very material increase in cost, this is certainly to be preferred, as it is practically impossible when wood is used for studding and joist to avoid future cracked plaster and other troubles caused by the shrinkage. Where wood trusses are used for roofs and other portions of the building they should be designed so that excessive shrinkage will not occur at the joining of the various members. Where plaster surfaces come in direct contact with the trusses, steel is much to be preferred. For roofs and for all sheet metal work copper is the best material. Proper provision, however, must be made in all copper work for contraction and expansion, otherwise the work will break at seams. When tin is used care must be taken to keep it well painted, otherwise it will disintegrate rapidly. For pitched roofs the best quali-

Lizotte Bridge, over the Riviere du Chene, at Saint-Jean-Deschaillons, Lotbiniere County (3 spans 1·200 ft.; 2 of 56 ft).

ties of slate are very good. For flat roofs, tar and gravel may be used where the cost of copper is prohibitive. For floors, compressed cork, marble slabs or terrazzo are very fine, where funds will permit of their use. Wood floors of maple, oak or yellow pine in narrow strips, side and end matched, well driven up and blind nailed to each bearing, treated with boiled linseed oil or varnish as condition may require, make a good floor. Wood for interior finish should be thoroughly seasoned and kept absolutely dry and should not be brought to the building until the plaster is dry. The treatment of walls and ceilings and interior finish will depend on the style of architecture and the general character of the building. Marble and Moasics have wonderful possibilities, as yet undeveloped in this country, for the treatment of wall and ceilings in Romanesque and Renaissance work. Wood ceilings may be used for Gothic work where stone or brick vaulting is prohibitive. Patent plaster when properly handled and applied on a solid backing is a good permanent material. Sham should be avoided both in the structural and finished portions of the construction.

In conclusion: more care in proportioning footings to the loads which they are to carry, better mortar and concrete, avoiding useless tin ornaments on the exterior, better protection for exposed portions of walls, using less wood and more masonry for structural parts, accepting only the best work in the construction generally—and we will have more permanent buildings.

Practical Points in Concrete Work

Broken stone should be nearly cubical in form, as thin, flat particles will not pack well. The shape of the fragments has an mportant effect on the proportion of voids in the mass.

The careful sorting out of steel reinforcing on the job not only tends to promote economy, but also largely assists and facilitates the work when it is necessary to begin the operation of bending and placing.

It is a mistake to leave the waterproofing work entirely to the contractor by not specifying the exact materials and the methods to be employed, as is quite often done. The specifications should be clear in the matter of indicating exactly what is required.

Form work for a reinforced concrete floor is at times so carelessly constructed that the ends of the shores or uprights rest on soft earth in such a manner as to allow the beams and girders to sag under the weight of the wet concrete. Where the soil is soft several planks should be crossed in order to get sufficient support to prevent settling under the weight of the concrete.

Bonding new to old concrete is a matter that requires the greatest care, as fresh concrete does not adhere strongly to concrete that has set. New and old concrete can be joined but the difference in the strength of such a connection is always uncertain. When concrete is being laid, there is always danger when part of the work has set over night, for instance, that the reminder of the work will not stick to the old part. Retaining walls will occasionally give evidence where one day's work ended and the next began, and frequently a crack will occur along this line.

All forms should have ample strength to support properly the loads they are called upon to carry. They must be strong enough to retain wet concrete, or they must be strong enough to withstand the pressure due to tamping in case a dry concrete is used. Loads of forms must be restricted to those for which the forms are designed, namely, the weight of the concrete and such construction loads as are necessary, like the weight of workmen, runways, wheelbarrows, etc. Storage on the forms of construction materials for future use should not be permitted.

There is no definite rule as to the length of time that arch centreing should remain in place. The time, however, should not be less than two weeks for spans up to 45 ft. if the arch is back-filled at once. When the centreing is not to be used again it is better to let it stand considerably longer. Arches of small spans up to 15 ft. may have the centreing removed in about a week's time. For very large arches the problem of removing the centreing becomes a special one and should receive the attention of the engineer.

Various Types of Roof Construction

A PAPER which was read a short time ago before the Incorporated British Institute of Certified Carpenters in London had for its subject "The Carpenter and Mason in Roof Construction," and dealt with the various types of roof used in classic and mediaeval times. The author, George Arnall, pointed out that construction was largely influenced by two factors—climate and material.

The Greek temples, although externally imitating wood construction, were probably roofed with wooden rafters supporting marble tiles. A temple at Paestum has, above the entablature of the inner row of columns, a second series of smaller columns, forming a kind of triforium, and apparently used for supporting wooden rafters. Roman roofs were largely constructed of concrete. The Pantheon and the Baths of Constantine are good examples of this form of roof construction.

There are few early examples of timber roofs of domestic buildings in England. Most of the remaining examples are of purely ecclesiastical origin. There is no evidence from records or diagrams as to the method of construction used before the twelfth or thirteenth centuries.

The oldest roofs now in existence may be divided into, roughly, two main classes: one with simple beams thrown across the walls, and the roof built up from this, supported on upright posts; while the other is represented by what we know as the collar beam truss. This latter was probably the older. Some thirteenth-century examples at Stokesay, Peterborough, Coddesden, and Sutton Courtney show the various methods adopted to overcome the thrust produced at the foot of the rafters. Heavy stone buttresses, built outside the walls, or brackets fixed under the collar and to the principal rafter, were the more general means.

Examples of the fourteenth century of the beam type can be seen at Dunstable Priory, Polebrook, and Cirencester, and a fifteenth-century example at Magdalen College, Oxford. In some cases the beam is chamfered, but in most cases brackets are introduced under each end of the beam, bringing the weight of the roof on to the inner side of the wall. The roof in these cases was supported on upright posts, no attempt being made to truss the roof in the modern sense.

Roofs of the hammer-beam type may generally be regarded as fifteenth or sixteenth-century work, but a fourteenth-century roof at Woplode has an arched rib resting on two projecting beams, which, however, meet in the centre. The thrust is taken to the wall by large brackets under. The earlier examples have high collar beams, with no trussing above; but the well-known examples at Hampton Court and Westminster Hall have this space trussed, and also a most elaborate system of windbracing.

Within the last few years attempts have been made to build timber roofs of fairly wide span by using modern market-size timbers. Mission halls at Cardiff, Croydon, and Burgess Hill have been erected in this way. The principal rafters are double, and are tied in at the foot by sloping collar beams, termed scissor beams. There are no wrought joints in the construction, butt joints and iron straps only being used.

These roofs, while proving very effective and handsome structures, have the additional recommendation of being much less expensive than the ordinary type.

A Well Known Winnipeg Contractor

Mr. T. R. Deacon, who has just terminated a two-year term as Chief Magistrate of the city of Winnipeg, is well known as the President and General Manager of the Manitoba Bridge and Iron Works—an enterprising firm which has carried out much important work in Western Canada, and which ordinarily has over five hundred men on its pay-roll. During his two terms in the office of Mayor, Mr. Deacon personally inaugurated several large engineering works, among which the most noteworthy is the Greater Winnipeg Water Supply scheme, which entails an expenditure of $13,500,000.

Mr. Deacon was born in Ontario in 1865, and graduated from the School of Practical Science in 1891. He has had extended experience in the general practice of engineering, constructional and manufacturing work, and has been connected with all the prominent business organizations of Winnipeg.

Mr. T. R. Deacon

Mr. Deacon is a conspicuous example of the ability of an engineer to discharge the duties of an important public office efficiently and successfully. So popular was his administration in Winnipeg that when his term was drawing to a close he was petitioned by four thousand of the city's leading business men to accept renomination.

Colonel Goethals, the engineer of the Panama Canal, and Sir Thomas Shaughnessy, president of the Canadian Pacific Railway Company, have been elected honorary members of the Institution of Civil Engineers.

LETTERS

The Use of Reinforced Concrete in the Erection of Large Buildings

Editor Contract Record:

I feel that I must ask you to let me avail myself of space in your valuable columns to reply to the charge made by Dr. Montague, the Minister of Public Works for Manitoba, that "Old Country architects know nothing about stresses and strains," and that "reinforced concrete is not suitable for the construction of large buildings"—particularly so in view of the fact that Dr. Montague's assertions are backed up by several of his colleagues, who claim to speak with authority.

There are many Old Country architects in Western Canada, including quite a number in this city, and some of these are highly trained and experienced in both architecture and construction, including reinforced concrete work—in fact, the author of one of the most practical and up-to-date works on stresses and strains in reinforced concrete structures is a resident in Winnipeg. The reason this matter has not been taken up is, I think, partly professional etiquette, and partly because the statement is not considered to be of sufficient importance to merit consideration, it being a matter of general ridicule, rather than a matter in the least likely to reflect discredit on British architects. The statement is so obviously due either to ignorance of the facts, or to the extreme need for an argument, however lame, to justify the excessive and unnecessary expenditure incurred by adopting a system of construction evidently recommended by Government employees in preference to that originally designed by an eminent English architect in consultation with an expert structural engineer.

The matter of general comment, however, is the exposed incompetence of so-called professional experts on matters involving little more than an elementary knowledge of construction. If such men as these are responsible for the designing and construction of the important and heavy structures such as are now being erected in this city, it is not surprising that so many failures occur, and that so many structural defects develop so quickly after erection—in fact, it is more than a surprise that this lack of technical knowledge has not resulted in more serious consequences.

Personally, I have been much interested, and at times greatly amused, at various statements made at intervals during the inquiry, especially concerning reinforced concrete construction. It is very evident that the enormous advantages of this important material are not well known on this part of the continent, or at least, by those responsible for the construction of the Parliament Buildings.

During the inquiry it has been said that reinforced concrete is not suitable for the construction of large buildings. What a ridiculous statement! It is certainly unsuitable if either the designing or the superintending of construction is done by an incompetent, or by any one who has not made a special study of this class of work. Only reinforced concrete experts understand the full importance of this.

Old Country designers are well known to be exceptionally expert in the theory of stresses and strains, and in the principles governing the designing of reinforced concrete structures which are quite distinct from those governing the designing of steel work, hence the greater popularity and success of reinforced concrete work in the Old Country.

A failure of reinforced concrete work at Brandon was cited to support the statement that this construction was unreliable. The cause of the failure, however, was not mentioned. If the work was designed by a reinforced concrete engineer, I should like to know if the steel was placed according to the drawings, and if the concrete was gauged and mixed according to specification, also what time elapsed between the pouring of the concrete and the removal of the forms.

The Transcona elevator was also mentioned. The failure of this structure was evidently due to poorly designed foundation. What would have happened if the superstructure had been of any other material than reinforced concrete? What would have resisted so well the enormous strain to which it was subjected during tilting and restoration? I doubt if it would now be in existence if the construction had been other than reinforced concrete.

With reference to the suitability of reinforced concrete for large buildings and foundation work, I beg to state that the Old Country designers have more varied and difficult atmospheric, subsoil and other conditions to deal with than exist in this province, and even for large buildings, it is only in exceptionally unreliable soil, such as silt, or sand and peat through which water percolates, that caissons are adopted in preference to reinforced concrete.

Of the numerous examples of building comparing favorably with the Parliament Buildings, I offer a few particulars of two well-known structures, the General Post Office King Edward Street, London, Eng., and the Royal Liver Building, Liverpool, England. The former, designed by Sir Henry Tanner, in collaboration with Mr. L. G. Monchel, reinforced concrete engineer, was completed, I think, in 1910. At the time of construction, it was said to be the most extensive piece of concrete work in existence. A portion of the building is seven storeys high. The dimensions of the basement are 446 by 210 feet. The total floor area is 467,000 square feet, the cubic content about 9,000,000 cubic feet. The entire structural details, including foundations, walls, beams, floors, roof, staircases, elevator shafts, and a furnace shaft, 4 ft. 6 in. by 130 ft. high, are reinforced concrete. The floors are only 3½ inches thick and designed to carry a superload of 100 lbs. per square foot. The external wall panels are six inches thick by 34 feet long between the columns; the internal main columns, each supporting 520 tons, are 28 inches square. The retaining wall supporting the roadway where the traffic is exceedingly heavy, is 27 feet high, and in thickness varies from 7 to 8 inches. The subsoil upon which the reinforced concrete foundation is constructed is in part hard pan or gravel overlying clay, the remainder is clay, similar to what we have here. No caissons were used. In January, 1911, before the Royal Institute of British Architects, Sir Henry Tanner stated that the entire work was thoroughly satisfactory, and that no settlement had occurred, and in strongly recommending that class of construction, he said that by adopting reinforced concrete in preference to steel construction, they had effected a saving of over twenty per cent., this being the saving originally estimated. The actual cost turning out the same as the estimated cost.

The Royal Liver Building, erected a considerable time after the General Post Office, was at the date of completion considered to be the most imposing example of reinforced concrete work in existence. The height to main roof is over 170 feet, the domes of the two main towers are 295 feet above grade level, the total height from basement floor level to top of towers is 320 feet. There are seventeen storeys, including six in the towers. The location is close to the River Mersey, and on a site formerly occupied by the St. George's Dock. On account of this, the soil was of a soft, sedimentary nature, and was absolutely incapable of supporting any appreciable load, consequently concrete caissons were adopted and taken down to the sandstone formation which was found at a depth varying from 32 feet to 47 feet below grade level. The caissons are connected to a reinforced concrete raft upon which are distributed the loads from the columns, walls, etc. The entire structure is of reinforced concrete, with a granite facing. This facing, however, is not a structural detail. It is supported at each floor level by the reinforced concrete frame. The designing involved unusual and difficult constructive problems, necessitating beams for spans of 50 to 60 feet to carry 1,600 tons concentrated at two points in addition to a distributed load of over 100 tons, also columns to support loads of 1,600 tons. Where is there any loading approaching this in the Parliament Buildings? I understand that the whole work has proved entirely satisfactory, and that the building is a striking monument to the possibilities, advantages, strength and economy of reinforced concrete.

A volume of world-wide examples could be given, proving conclusively that reinforced concrete is eminently suitable for the construction of large buildings, provided the designing is in the hands of competent engineers, and the erection under expert supervision. Reinforced concrete work well designed and executed is of immense strength, which increases with age, while the strength of steel diminshes. It is far superior to steel work in durability, fire resistance, and wet situations, is more economical, and contains no joints, which are sources of weakness in steel work.

OLD COUNTRY ENGINEER.

Winnipeg, April 5.

Heating Concrete Aggregates

TO the question, "What is the highest temperature to which concrete materials can be heated without injuring the concrete," asked by Concrete-Cement Age, Mr. W. M. Kinney, of the Universal Portland Cement Company, Chicago, replies as follows:

Too high a temperature will cause many sands to turn red, while certain varieties of stone and gravel if over-heated are likely to soften or crack. A temperature not exceeding 150 deg. F. will generally prove most satisfactory. It should be remembered, however, that one of the objects in heating aggregates is to insure that the concrete when deposited will have a temperature of approximately 100 deg. F., which will assist in the development of internal heat and promote early hardening, provided adequate protection is afforded for such length of time as is necessary to accomplish this object. Heating by steam has an advantage over heating by the use of the ordinary types of sand heaters. When these are used there is a possibility of damaging some of the material next to the heater from the extreme heat often necessary to thaw out sand or gravel at the top of a pile, unless it is occasionally turned to insure uniform heating.

Sand and stone may safely be heated by piling them directly on pipe coils supplied with steam, or by covering with tarpaulins and applying steam directly to the materials. Short pieces of iron pipe connected with the boiler by lengths of hose are often stuck into piles of aggregates and steam allowed to escape through the materials. With a good steam pressure this system is quite effective and has the advantage of avoiding rehandling of materials, which is often necessary when using other methods.

Finances having been arranged, Laurentide, Limited, will recommence the construction of the 90,000 horse-power development at Grand Mere, P.Q. Soon after the war started the work was stopped, a large amount of the contract having been carried out by the H. E. Talbott Company.

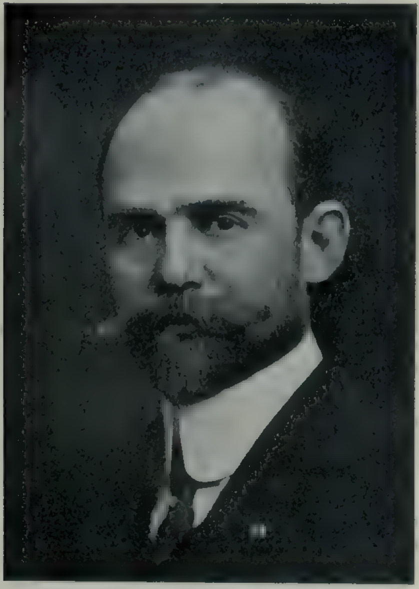
Personal Mention

Mr. G. Drinkwater, Town Engineer of St. Lambert, P.Q., has returned to Montreal after taking a cavalry captain's course of two weeks at Stanley Barracks, Toronto.

Mr. Lucius E. Allen, of Belleville, Ont., Engineer for Hastings County, was a visitor at the office of The Contract Record last week. Mr. Allen paid a visit to Ottawa before returning to Belleville.

Mr. W. R. Harris, of Regina

Mr. W. R. Harris, of Regina, who conducts the Western business of The Canadian Lock Joint Pipe Company, is introduced herewith to those of our readers who have not had the pleasure of meeting him.



Mr. W. R. Harris.

Mr. Harris has had an extended and interesting experience in the engineering-contracting field, and a brief sketch of his career is appropriate to these columns. Born at Louisville, Ky., in 1876, he was educated in the local public schools and at the Manual Training High School, after which he went through some practical work in a machine shop, and following it up by becoming a draughtsman and estimator in architectural iron and structural steel work. For five and a half years he was Engineer for The Ohio Valley Telephone Company and for its successor The Cumberland Telephone Company, having charge of all the work in connection with the design and construction of underground conduit and cable systems, aerial cable work, the construction of new exchange buildings, and other enterprises. For two years he was with a well-known Cincinnati contractor, Mr. G. M. Gest, for whom he carried out important operations in underground conduit work, street paving and other municipal activities, and the reconstruction of street railways. After carrying out a railway job in the Cumberland Mountains of Virginia, he went to the firm of E. H. Abadie & Company, engineers and contractors, first as Office Manager and then as Chief Engineer and General Superintendent. For this firm he was engaged in the design and construction of electric light and power plants, including underground conduit systems, central and district heating systems, municipal work, and so on. From May, 1907, to January, 1909, he was the senior partner of Messrs. Harris, Craven and Von Borries. Three years later he became President of the Harris Engineering Company, successors to the preceding partnership. The activities of this firm embraced general engineering and construction work of all kinds.

Mr. Harris went to Regina in 1910, expecting to remain but six months in charge of the contracts for the Lock Joint Pipe Company, New York, for which firm The Harris Engineering Company had the agency in Kentucky and adjoining States. In January, 1912, The Canadian Lock Joint Pipe Company, Limited, was organized by a number of Regina business men, and Mr. Harris was elected to his present office of Managing Director and Secretary-Treasurer.

Mr. Harris has written a number of articles for the technical press. He has invented special tools and appliances for underground conduit and cable work, and is the inventor and co-patentee of a system of continuous reinforced concrete pipe for subaqueous work used by the Public Service Corporation of New Jersey and others. He is the designer of a special system of underground conduits for the accommodation of high and low tension electric cables.

In the sphere of professional societies, Mr. Harris is best known as a Past President of the American Society of Engineering-Contractors. He is a member of the Regina Engineering Society and of the Louisville Engineers' and Architects' Club.

While a resident of Kentucky, Mr. Harris served three years in the First Regiment of Kentucky Infantry, attaining the rank of Captain and Adjutant. On two occasions he was appointed by the Governor of Kentucky a delegate to the National Rivers and Harbors Congress, held annually in Washington, D.C.

The annual report of the Department of Railways and Canals gives some interesting figures as to the work on the Severn River. Thirteen concrete dams with stoplog sluices will be required for the regulation of the river. Six of these will be small dams at Washago. With a low water flow of 808 second feet the gross horse-power on the river between Wasdell's Falls and the Georgian Bay is about 12,000. The canals and channels with banks showing above water will have a minimum bottom width of 80 feet and the submerged channels will have a minimum bottom width of 100 feet. The canals and submarine channels will have a minimum depth of nine feet at normal water level. There will be eight steel bridges, five of which will be for highway and three for railway traffic. One railway and three highway bridges will be swing spans, the remainder being high level fixed bridges. In the latter case the minimum clear head room will be 35 feet between normal water and the lowest steel. The locks will be of concrete and will have eight feet four inches of water on the sills, with chambers 33 feet wide by 175 feet of 1,000 tons whose size will be 150 feet long by 30 feet beam and drawing eight feet of water. The lock at Swift Rapids will be unique, inasmuch as when completed it will probably have the highest lift of any lock of this type in North America.

The new 1915 catalogue of The Stratford Manufacturing Company, Limited, illustrates, among a variety of other interesting things, a line of extension and single ladders, scaffolds, trestles and brackets. Contractors requiring equipment of this kind should not purchase it without looking over this catalogue, as it is illuminating in regard to the kind of stock used by the company and the special features of design and construction that enter into the manufacture of these products.

The Canadian Wallboard Company, Limited, Toronto, has been incorporated with a capital of $50,000 to manufacture wallboards, roofing and building materials. The incorporators include H. Riley, W. B. Sturrup and A. Bicknell, all of Toronto.

Mainly Constructional

East and West From Coast to Coast

The contracting firm of D. Shefter & Son, Montreal, has been registered.

Applications have just been received for the vacant City Engineership of Cranbrook, B.C.

A movement is on foot to establish a Builders' Exchange at Guelph, Ont. Mr. George Gander, of Toronto, is interesting himself in the proposition.

It is stated that Mr. F. F. Woods, of Niagara Falls, Ont., has succeeded in financing the proposal to build a two-million-dollar drydock at Owen Sound, Ont.

The Simplex Asphalt Paving Company, Limited, has been incorporated at Quebec with a capital of $100,000. The incorporators include F. H. Markey and W. W. Skinner, both of Montreal.

On Thursday, April 22, Mr. Frederick E. Brown, M.Sc., will read a paper before the Canadian Society of Civil Engineers, Montreal, on "Decay in Timber." The paper will deal especially with deterioration of timber in construction work.

Work on the Government grain elevator at Vancouver will not be started until the 1st June. The local representative of the contractors, Messrs. Barnet & McQueen, states that his firm will not be ready to receive any tenders until this date.

The MacIntyre, Haining, Kelly Construction Company, Limited, Sault Ste. Marie, Ont., has been incorporated with a capital of $40,000. The Provisional Directors of the company are A. MacIntyre, of Steelton, Ont., J. H. Haining and E. Kelly, of Sault Ste. Marie.

The city of Verdun, P.Q., proposes to raise $400,000—to be spent as follows: paving roads, gullies and crossings, $250,000; acquisition and improvement of park lands, $75,000; water-works and electric lighting extension, $50,000; water mains and sewers, $25,000.

Water-works estimates amounting roughly to $376,000 have been presented to the Vancouver Council by Mr. F. L. Fellowes, the City Engineer. This amount includes $245,000 for sinking fund and interest. The total expenditure of the Board of Works this year is placed at $685,000.

The new bank and office building at Windsor, Ont., for The Canadian Bank of Commerce has progressed as far as the roofing stage. The building is four storeys high, of fireproof and brick construction, and is costing $150,000. The general contractors are Messrs. Norcross Brothers.

The Provincial Government of British Columbia is considering the improvement of the Cariboo Road between Yale and Hope, with a view to making it available as a motor highway. The statement emanates from Mr. G. P. Napier, Assistant Engineer with the Provincial Department of Public Works.

The new St. John bridge, the largest two-hinge single span arch in the world, was the subject of an address delivered last week at St. John, N.B., by Mr. A. R. Sprenger, the Government engineer-in-charge. The span of the bridge is 565 feet between hinges. The structure will be provided with two sidewalks, each 7 feet wide, and a roadway 36 feet wide. Mr. Sprenger spoke of the constructional difficulties encountered in the gorge, where a swift current, deep water and steep slopes called for careful design and execution.

The James Frid Company, Limited, has been incorporated to carry on business as general contractors. The capital stock is $100,000, and the incorporaors are J. W. Frid, A. Frid, M. Boag and W. J. Aylett of Winnipeg. The chief place of business of the company will be Toronto, Ont.

The Sarnia Bridge Company, Limited, Sarnia, Ont., manufacturers of all classes of structural work, bridges, buildings, etc., have opened an office in Toronto, at 103 Pacific Building (corner of Scott and Wellington Streets). Mr. E. B. Price, who is in charge, is well known to the contracting and engineering interests.

Last week the corner-stone of the new Registry Office on Albert Street, Toronto, was laid by the Mayor of the city, Mr. Church. The architect of the proposed building is Mr. C. S. Cobb. Mesrs, Oakley & Son are the cut stone contractors. The cost of the building is estimated at nearly $400,000. Work was commenced last September.

At Toronto, work on the Parliament Street section of the Bloor Street Viaduct is now in full swing. The Dominion Bridge Company are the contractors for the work, while the Raymond Construction Company have the sub-contract for the excavation work. Last week there were upwards of 125 men on the job. The Raymond Construction Company is employing only four Italian laborers; all the rest are English-speaking.

The Brown's mill dam bridge over the Tete a Gouche River, Bathurst, N.B., to be constructed for the Provincial Government will be 1,853 feet long, including the approaches. Tenders for the sub-structure and approaches are to be in by May 5. The bridge is, for working purposes, divided into twenty-two sections, including six concrete pedestals, two concrete abutments, and four rivetted deck steel truss spans, each 54 feet long.

The City Council of London, Ont., have received from Messrs. John Moore and Arthur E. Nutter, representatives of the Local Chapter of Architects, a request for the revision of the building by-law. The Forest City code is said to have many shortcomings. It is pointed out that pencilled plans of alterations such as are now being used can easily be altered, and it is asked that all plans be blue-pencilled and officially stamped before the issuance of permits.

Mr. H. S. Van Scoyoc, Chief Engineer of the Toronto-Hamilton highway, is starting in earnest on the construction work. A large number of men are to be employed, and small locomotives and trains of dump cars will be put in commission. An employment office is being opened in Toronto, and in addition to the winter camps at Clarkson's and Burlington, new ones will be struck at points four miles west of Clarkson's, four miles east of Oakville, one in Oakville proper and another four miles to the west. Accommodation will be provided for one thousand men. The new railway will call for eighty steel cars and fifteen miles of trackage, and access will be had to the G. T. R. or lake points. The cars will be made in Canada, after an original design of the Commission's engineer, and will hold 1½ cu. yds. of earth which can be handled quickly. According to estimate, this work will cost $60,000 less than by employing ordinary means. Freight tonnage will reach 250,000, and two hundred teams will be needed to haul the constructional material.

Book Reviews

American Sewerage Practice; Vol. 2, Construction of Sewers; by Metcalf and Eddy. Published by the McGraw-Hill Book Company, Inc., New York City. Price $4.—This is the second of three volumes which treat of the more important principles of theory and rules of practice in the design and operation of sewerage works. The first volume, which was reviewed in our issue of January 6th last, dealt with the design of sewerage systems. This, the second one, covers their construction, and the third will be devoted to the design of works for the treatment and disposal of sewage. An idea of the comprehensive scope of the book may be obtained from the subject-matter of the chapters, which is as follows: Chap. 1, Preliminary Investigations; Chap. 2, Engineering Work and Inspection during Construction; Chap. 3, Excavation; Chap. 4, Machinery for Trench Excavation; Chap. 5, Methods of Rock Excavation; Chap. 6, Explosives and Blasting; Chap. 7, Quantity and Cost of Excavation; Chap. 8, Rate of Progress in Building Sewers; Chap. 9, The Sheeting and Bracing of Trenches and Tunnels; Chap. 10, Sizes of Sheeting, Rangers and Braces; Chap. 11, Purchasing, Handling and Laying Sewer Pipe; Chap. 12, Jointing Sewer Pipe; Chap. 13, Construction of Brick and Block Sewers; Chap. 14, Construction of Concrete Sewers; Chap. 15, Profiles, Templates, Forms and Centres; Chap. 16, Contracts, Specifications and Drawings; Chap. 17, Technical Specifications; Chap. 18, Operation and Maintenance of Sewerage Systems; Chap. 19, Explosions in Sewers.

In their prefatory remarks, the authors point out that the construction of a sewerage system involves attention to many apparently unimportant details which, if neglected, may materially diminish the value of the works. If the alignment and grades are not true, there may be places where the velocity of the sewage will be checked and deposits of sand and organic matter will occur. These not only reduce the capacity of a sewer, but if they remain for some time the organic matter decomposes and thus affects injuriously the sewage flowing over it, which should reach the place of disposal or treatment as fresh as possible. If the inner surface of sewers are not so smooth as contemplated by the designer, the resistance to the flow of the sewage is increased and the sewers will not have the desired capacity. In order to avoid these and other defects, the field engineering and inspecting force must insist on many things which are discussed in this volume but have been rarely taken up in books or papers on sewerage.

In addition to acting as designing and supervising engineers upon work executed by contract, the authors have had direct charge of the construction by day labor of many miles of sewers, large and small, in earth and rock, trench and tunnel. The construction of sewers from the contractor's point of view is, therefore, understood clearly by them. They have endeavored to present in this book the instructions they would issue to the superintendents and foremen in charge of day-labor forces, and the advice they would give to contractors taking up sewer construction for the first time. The authors believe that there is need of improvement in much of the sewer work done and that this improvement should be made in inspection as well as in the operations carried on by contractors, in construction done by day labor as well as in that executed by contract. Their experience has been that contractors generally have desired to do only the best work, but that they sometimes fell short of attaining their object through unfamiliarity with the special requirements for good sewers. This book will prove helpful to all such men, as well as to engineers and inspectors who should be familiar with practical methods of construction.

Land Drainage, by J. L. Parsons. Published by The Myron C. Clark Publishing Company, Chicago. Price $1.50. —This work, which is defined as "a treatise on the design and construction of open and closed drains," should be found valuable by drainage engineers and contractors, for the amount of existing literature upon this subject is limited, and much of the information that should be available for those connected with the design, construction, maintenance and general administration of drainage enterprises is either not in publication or has not been the subject of sufficient discussion and experimental work. The chapter on Costs, and that on Specifications, together with the practical details and illustrations, cannot fail to be found of much value.

Centrifugal Pumps, by R. L. Daugherty (Assistant Professor of Hydraulics, Cornell University). Published by the McGraw-Hill Book Company, New York City. Price, $2 net.—This is a useful book, which has been written with a view to serving the needs of the practising engineer desirous of obtaining a grasp of this subject. In it an effort has been made to cover the following ground: To illustrate and explain all the essential features of construction of modern centrifugal pumps, to present a clear and intelligible theory which shall be entirely general in its nature, to explain by this theory the pump characteristics and connect the theory with the actual facts, to present a thorough discussion of the factors affecting efficiency, to consider the characteristics of various types of pumps and their suitability for different services, to compare centrifugal with displacement pumps, and to present various general laws and factors leading to a better appreciation of the field of service of such pumps and a better means of selecting the proper combinations.

The material in this book is based upon a study of the performances of 123 turbine and 51 volute centrifugal pumps made by seventeen and twelve different companies respectively. The field covered by them ranged from one to eleven stages, heads from 7 to 1,843 feet, capacities from 108 to 132,000 gal. per minute, speeds from 62 to 20,000 r.p.m., and efficiencies from 30 to 87 per cent.

"New Pavements for Old."—Under this title The Barber Asphalt Paving Company (Philadelphia) has issued a pamphlet on the resurfacing of old pavements with sheet asphalt and asphaltic concrete. The best methods to be followed and the pitfalls to be avoided in work of this kind are pointed out. It is declared to be "the worst kind of waste to throw away an investment in old brick, concrete or even macadam highways when these can be used as foundations for new pavements."

Water and Sewerage Work at St. John

According to the annual report of Mr. R. W. Wigmore, Commissioner of Water and Sewerage at St. John, N.B., the amount expended in this department of the city last year was rather less than $280,000. Among the construction work was the building of a 36-in. masonry sewer along the shore of Marble Cove—a distance of about 1,800 feet, at a cost of $15,000. This sewer diverts the drainage of about 24 acres of closely-built territory from the shores of Marble Cove to the swift current of the river.

The City of St. John is divided into two separate portions by the broad and deep waters of the river and harbor of the same name. For this reason the water supplies are derived from two distinct sources, with the city between.

The East Side was formerly supplied through two 24-inch pipes and one 12-inch, all of cast iron, from Little River Reservoir, an artificial lake five miles distant, containing about 122,000,000 gallons, and formed by damming the valley and causing the water of Little River to expand to an extent of 55½ acres. This reservoir is now held in reserve.

The supply from Little River has been discontinued and a conduit extended to Lake Latimer from the head of the former system, whereby an additional head of about 135 feet is obtained and the pump at Silver Falls abandoned. This conduit consists of 7,420 feet of reinforced concrete conduit of an average diameter of 39 inches and 9,880 feet of 33-inch wood stave pipe and 400 feet of C. I. pipe.

Lake Latimer has an area of about 200 acres. Its supply is augmented from Loch Lomond through Robertson Reservoir by 6,918 feet of concrete conduit with a sectional area of 12.75 square feet and known as Conduit No. 2.

The West Side is supplied through 4.8 miles of cement lined 12-inch pipe and 5½ miles of 24-inch cast iron pipe, from Spruce and Ludgate lakes, an extensive expanse of water still retaining the two names but united into one sheet by the building of a dam at the outlet of the lower lake (Spruce Lake) in the year 1866, and the consequent raising of the water to and above the former level of Ludgate Lake.

A distribution reservoir is situated at the termination of the West Side 24-inch main. The elevation of its surface is generally kept at about 150 feet above high water datum St. John harbor. Its capacity is about 1,500,000 gallons.

Excavating and Tamping Machinery

From Messrs. Pawling & Harnischfeger, Milwaukee, Wis., we have received a pamphlet setting forth the features of some of their excavating and tamping machinery. One of the machines illustrated is the firm's standard machine, equipped with contractors' type of digging wheel, with delivery to one side by means of a conveyor. Another one shows the "P. & H." standard machine equipped with a special Gumbo wheel and chutes for delivery on both sides. The story of a tough job is told in this pamphlet by Robert Shannon, a drainage contractor, who tells of the success he had with the company's No. 152 K.C. machine. He writes: "During the first two hours' run of this machine, I dug 126 ft. of trench 9 ft. deep and 27 inches wide through 4 ft. of rock fill, and in under soils varying in character from sand to hardpan, and all very thickly layed with large boulders, and limestone rock. In addition to the normal cutting capacity of the buckets I had on the machine at that time, we used crowbars to loosen the earth on the side of the trench to a width of 42 inches, and allowed the extra earth to fall into the buckets, thus forcing the machine to handle this great volume of earth. Needless to say, it did this in an extremely satisfactory manner. I have since that time cut approximately 10,000 feet of trench, varying in width from 27 inches to 46 inches and from 6 ft. to 18 ft. in depth, with this machine, and had no trouble whatever with any part of it. The engine on this machine has ample power to pull it under all circumstances, and since it burns kerosene, my fuel item is almost nothing. In one day I opened 800 ft. of trench 9 ft. deep, 27 inches wide. I have averaged about 500 ft. of trench per day throughout this entire job. My cost of operation is as follows: Salary, two men $7.00, fuel 30 gallons of kerosene at 6c., $1.80. Lubricating oils and grease, estimated at 50c. per day."

After considerable discussion, the Montreal Board of Control have awarded the contract for a civic library to the John Quinlan Company, the lowest tenderers. The price is $445,000. Queenstown blue limestone is to be used, the ten columns being of Stanstead granite, for which $16,000 extra will be paid. Megantic granite will also be employed in certain parts of the building. Only Montreal workmen are to be employed. Mr. Ainey, one of the controllers, was not favourable to awarding the contract to the successful firm on the ground that the names of the sub-contractors should be given, as he is of opinion that it is impossible to carry out the contract without employing sub-contractors. Mr. Quinlan however dissents from this view, and asserts that he is able to do the work without the aid of sub-contractors.

A 35-Ton Steel Derrick

The Pollard Manufacturing Company, Limited, Niagara Falls, Ont., are one of the most progressive manufacturing firms in the Niagara Peninsula. They are now located in their fine new plant which contains all the latest equipment for turning out derricks, hoists, cranes, and stone and marble-working machinery.

The accompanying illustration is of a 35-ton steel derrick, made with a 90-ft. mast and a 75-ft. boom derrick installed at a marble quarry in Quebec and said tobe the largest of its type in Canada.

Pollard steel guy derrick.

The machine was aranged to lift 20 tons on a single line, the hoisting cable being 1½ ins. in diameter. The machine was arranged to lift loads of over twenty tons at half the speed, by hooking the end of the hoisting line into a bale at the end of the boom, making a two-part purchase.

The two sheaves in the hoisting line are 3 ft. in diameter, and the steel sections 4 ft. square at the centre. The bull wheel was 16 ft. in diameter and the whole derrick weighed 26,000 lbs. The sections were joined at the centre so that the whole shipment was made on one car of large capacity.

Bulletin No. 24X, issued by the Pawling & Harnischfeger Company, describes and illustrates the "P. & H." Ladder Type Excavator, a piece of equipment which effectively meets the requirements of deep trench-digging. "P. & H." trench excavators are known as "All-Steel" machines, because they are built almost entirely of steel.

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The Dawn of Better Things

**"Weeping may endure for a night,
But joy cometh in the morning."**

THAT the night of depression which came upon us last fall is being followed, in the natural order of things, by the dawn of confidence is evidenced in many significant developments of the last few weeks. One of the best signs of improved commercial conditions is the increased earnings of the railroads. The business transacted by the Canadian Pacific Railway has come to be regarded as a sort of barometer of Canadian prosperity, and it is worthy of note that the net profits of that road for February, 1915, were nearly forty per cent. more than they were in 1914. It is only fair to point out that this improvement is due partly to a curtailment of the working expenses of the road, but it is attributable in substantial measure to the gratifying returns of the gross earnings for the month.

The C. P. R. figures are the forerunner of the general expansion of commercial activity which Sir George Foster has been predicting. The C. P. R. is a well-managed road, but so is Canada a well-managed country, and with business conducted on sane and conservative, yet withal on enterprising lines there is no reason why the experience of the railroad should not become a general one. The ever-increasing strength of the allied forces, and the disclosure of Great Britain's mighty reserve of men and money, have had effect—measureable and striking effect—at last, and as a result we find uncertainty giving way to certainty, and shaken faith to renewed confidence. The financial outlook is brightening, and on nearly every side the markets are reflecting the improvement in the tone of business. The underlying economic conditions are sound, and there is every reason to believe that the general advance will proceed. Some people will tell you that in any case the depression through which this country, together with the United States, has passed during the last year or two has been overdone—that the United States has had the largest crops in its history—that the Federal reserve banks have put business credits in an easy position—that the War has created new and tremendous markets for United States products, as it has for Canadian agricultural products—that the Canadian banks have accumulated large funds—and that generally the resources of a continent have accumulated and placed the issues of the future beyond doubt. Certainly it is fair to assume that with money being used almost entirely for productive purposes during the next few years, and with real estate speculation tabooed, general business improvement cannot be delayed.

The constructional activities of the country are always the slowest to reflect commercial improvement, but reports from many of the leading centres show increasing activity. There is no reason why considerable building should not be carried out this season. We can only translate our confidence in terms of dollars and cents. Many there may be who will hold back, but many there must be who will recognize the advantages of building this season. In the building trades materials and wages have been on the upward grade for years, and everything points to a continuance of this tendency at no distant date. Materials will never be cheaper, labour will never be more plentiful, and one would not be speculating very wide of the mark in saying that contractors' estimates will be ten per cent. higher next year than they are this.

In regard to the increased cost of construction after the War one finds common agreement the world over. Only the other day we were reading an interesting communication on the subject submitted to a London (Eng.) contemporary by Mr. Edgar L. Chappell, of Cardiff, who based his prediction of increased cost upon the following argument, the principles of which are equally applicable to Canadian business:—

> (1) Owing to the general insecurity, the tightness of the money market, and the increased cost of materials, an enormous amount of work that had been contemplated before the commencement of the War has not been proceeded with. It is probable that the value of such suspended contracts in the United Kingdom considerably exceeds £100,000,000, and we should probably allow for at least five times this amount for Continental suspensions. On the termination of hostilities the bulk of this work will go forward, and the demand for material will be enormous.
>
> (2) In addition, the towns and villages of Belgium, France, and Poland that have been partially or wholly destroyed will need to be rebuilt, and we may safely expect that the huge demand for material thus set up will have a tightening effect on the markets.
>
> (3) For many years past the prices of most classes of commodities have advanced very considerably. Since the outbreak of the War the increases have been abnormal, and, although reductions are probable when peace is restored, it is not likely that prices will return to the pre-war level. It may be assumed, therefore, that the cost of living after the war will be higher than the cost before the war. In that event there will be considerable labour unrest, and wages in the building trade, as in other trades, must go up. The demands of the building artisans and labourers will, of course, be resisted, but as the labour needs of builders are likely to be great, whereas the volume of available labour will be reduced by the wastage of war, the men are almost certain to have their demands conceded.
>
> (4) We are informed that after the War there will be a huge boom in trade. In that event the demand for capital will be great, and the rate of interest will be high.

The time for speculating as to the trend and duration of the War has passed. Germany is a beaten nation to-day, and it is little of our concern just how long it will take to bring the enemy actually to his knees. We who are not contending on European soil, and who have not the privilege of acting as confidential advisers to the British Government, are concerned only with contributing our bit to the business stability of this country. The cause of the Empire and that of the Allies may safely be left in better hands than ours. Our course is clear. The rejuvenating spirit of spring is upon us, and **now** is the time for action.

Before the war the whole of the tungsten powder used in the manufacture of high-class steels for shell-steel, armour and cutting tools used in all engineering works and armament factories was imported from Germany. A British firm has now been established to capture the industry, the combined company representing all the great steel firms of Sheffield, and others. The object is to refine and provide their own tungsten, and such good progress has been made that supplies on a commercial scale will be shortly produced at the company's factory at Widnes.

Greater Care in Employing Workmen Will Pay the Contractor

MAKING some effort to determine whether each man hired on a construction job will fill the bill is a thing that is both very desirable and seldom done. A contractor may well ask himself the question, "Do I get the most efficient force that could be picked from the men who apply at my jobs, and if not, how can I get it?"

Many superintendents and general foremen are capable of picking the right men for their work, and many make it their business to employ personally every man that is taken on. If the superintendent is a good judge of men this is the best way to take care of the matter. The trouble is that often the man in charge is either a poor judge, and knows it, or is too busy to attend to employing the men. Consequently, he leaves it to the foremen, who often are not able to tell a good man from a bad one till they see him work. As a result, foremen come to expect nothing from any man they put on, and form the habit of discharging men for the most trifling mistakes. A foreman who gets into this rut is never able to build up a good crew, or get the best out of the good men he does pick up. And when a foreman is not honestly trying to pick the best men he can, regardless of other considerations, various abuses creep in, and the efficiency of his gang often drops very low.

A campaign to educate foremen in this matter of selecting men, especially with a large company, would be nearly hopeless. For one thing, foremen with a large concern are often changing. Many men make first-class foremen who do not have it in them to be good judges of strange men. The general foreman, or superintendent, however, is rightly supposed to be of a superior class, and it can reasonably be demanded of him that he should know how to employ men.

The solution, then, is for a contractor to select his executive force so that he can put on each job at least one general man who is competent to do the hiring. Next, he must see to it that this man has time to attend to the matter. If the man be the superintendent, and his time is taken up with office detail, an assistant, or engineer, can relieve him so that he will be able to devote the needed time to employing his men. Such an assistant will more than save his pay in increased efficiency of the working force. It is a great mistake, in general, to take up a superintendent's time with signing checks, making reports and doing instrument work, if he is also the man relied on to plan and execute the construction.

If the general foreman is selected to employ the men, and his job keeps him too busy to attend to it, there is usually a quick solution of the difficulty. The things that take the general foreman's attention from arranging the work for his crews and helping to plan the progress of the job may be divided into two classes—breakdowns of equipment and blunders by the men under him. Contractors should spare no pains to minimize both these things, aside from the mere question of employing men. The extra money that represents the difference between equipment that is ready to run twenty-four hours a day and equipment that runs part time, and between competent and incompetent foremen, is literally only saved when it is spent. When it is spent it is usually much more than saved. If your general foreman does not have time to hire his men when the job is running smoothly, that is evidence enough that he is doing more work than one man should. Either the superintendent should be free to help him, or he should have a competent assistant.

The selection of those foremen and mechanics who are not readily picked up at the work, and who are carried by a contractor from place to place, should be made, or at least passed on, by some one person in the main office who is an expert at the business of knowing a man when he has talked to him. No man should be taken on without a personal interview. A fair-sized contracting business can well afford at least one expert of this sort, whose main concern is employing men. Many readers will be able to recall instances where, for lack of such an expert, contractors have suffered from the most ridiculous mistakes made by men sent as competents by the main office.

Having provided a definite man to employ others on each job, a contractor should watch that feature of the work carefully, and see whether each particular man's judgment can be improved. On visiting a contract it is often easier to tell what is wrong than to right it. If the wrong men are employed on one of your jobs, or men picked for one class of work are doing other work for which they are not fit, a little observation will disclose the fact. To set it right, however, may require both tact and patience. Nevertheless, it will not be hard to find men enough in the average executive force who can at least be taught to do this work, if they are not able to do it already.

To interest these men and train them to this way of doing is at the present time the best of business. The man who waits till competition forces him to adopt a progressive measure stays right where he was before his competitors began to adopt it—a little to the rear of the procession and profits.—D. H. Hammond, in The Engineering Record.

Building the Substructure of the G. T. P. Bridge over the Fraser River at Prince George, B. C.

Staff article, prepared from data and illustrations kindly furnished by Mr. E. Stanley Holland, Vice-President of the Bates & Rogers Construction Company, Chicago.

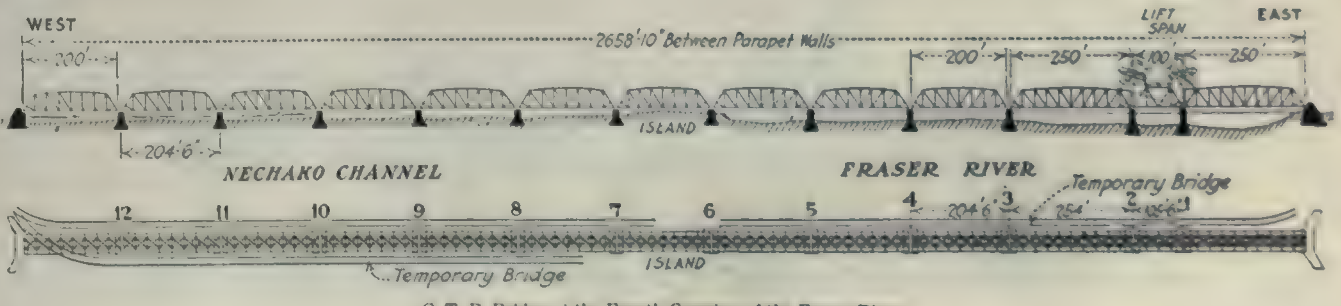
ONE of the interesting features of construction on the Pacific Coast section of the new Transcontinental line of the Grand Trunk Pacific Railway is the bridge foundation work along the Fraser River between Tete Jaune Cache and Fort George in British Columbia. The largest and most important of these structures is over the Fraser River at Fort George—or Prince George, as the new railroad town is named—known as the Fourth Crossing of the Fraser River.

For one hundred and eighty-five miles between Tete Jaune Cache and Prince George, the railway follows the Fraser River through several ranges of mountains, the distance by river being over three hundred miles. The country is wild and rugged and inhabited mainly by Indians and trappers.

In the summer, the melting glaciers and snow turn the Fraser into a deep, swift river. It was not possible for the railway company to maintain a temporary bridge across this river during the entire year, and for this reason it was necessary to construct the substructure well in advance of track construction.

Under these conditions it was necessary to transport all camp and construction equipment and supplies, as well as cement, to the site of the work long before the railroad had arrived. The nature of the country was such that wagon roads were impossible. The only means of delivering this material was by boat or scow on the Fraser River, which is navigable only during the high-water period. Actual construction had to be carried on during the low-water period, which usually begins during September or October and continues until April or May. A number of sternwheel steamers, of the usual type, were operated on the river, but they could not begin to handle the tonnage. For this reason, scows, from 36 to 40 ft. long, and from 12 to 14 ft. wide, carrying 12 to 25 tons each, were floated down the river from the end of steel to the site of the work. They were handled by sweeps at each end, each sweep being manned by two men. In the more dangerous canyons and rapids, pilots and several additional men were put on to assist the crews, but even with this precaution, entire cargos were frequently lost. The average mileage a day for a scow was 50, with a maximum of 70 miles. Notwithstanding the difficulties attendant upon this method of transportation, over ten thousand of a total of eighteen thousand barrels of cement for the Fourth Crossing, as well as camp supplies and almost all of the construction equipment, were taken down the Fraser River in this manner, a maximum distance of over three hundred miles.

During the winter season, a considerable amount of freight was handled by teams travelling on the ice in the river. Freight was handled in this manner for a maximum distance of 150 miles. At one time in



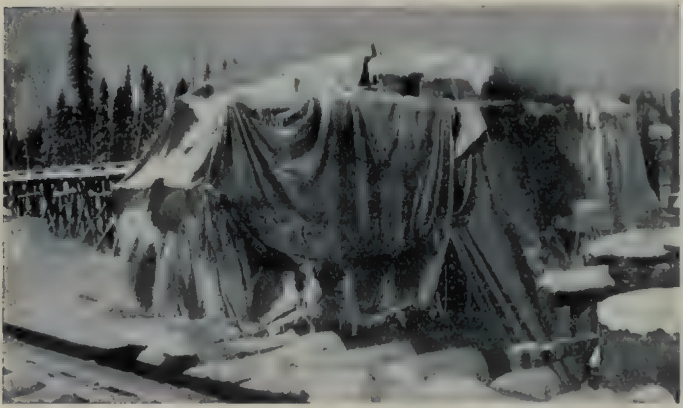
G. T. P. Bridge at the Fourth Crossing of the Fraser River.

mid-winter, when the ice conditions were good, about four hundred teams were hauling equipment and materials. Some two-horse teams would haul as much as seven tons.

After the close of navigation, getting to the site of the work was a difficult matter. Dog teams were occasionally employed, and at some points teams could be used along the railroad company's embankment. Frequently it was necessary for the contractors, superintendents and others to walk one hundred miles or more to reach the work.

The general contractors for the construction of the railroad had a single line telephone system serving all camps along the line. This was a great help, although the single wire was inadequate for the service required.

The bridge at the Fourth Crossing is just below the confluence of the Fraser and Nechaco Rivers. Here the line crosses an island with the deep water channel, known as the Fraser Channel, on the east side, while the Nechaco Channel, an overflow during highwater, is on the west side. The length of the bridge at this point is 2,658 ft. A plan and profile are shown herewith. The contractor's camp was located on the island between the Fraser and Nechaco Channels and accommodated six hundred men. The bunk-houses were frame buildings covered with prepared roofing. The store houses for cement and material were large frame buildings covered wth heavy tarpaulins, of exceptionally fine canvas—made in Scotland. Most of these tarpaulins had been used for protecting cement on the trip down the river. An auxiliary camp to accommodate one hundred men was established on the east bank. This was rendered necessary on account of the great danger, due to floating ice, in taking laborers across the main channel before the contractor's temporary bridge was completed. The establishment of this camp proved very fortunate, for in the spring, when the ice took out a large part of the temporary bridge, the work on the east bank was carried on without interruption.


Method of protecting concrete in severe weather.

A complete day and night organization was maintained during the entire work, each pier of the Fraser Channel having a complete plant as well as an individual crew. A night and day foreman for each pier worked together, shifting the crews every two weeks. Each foreman reported to the general foreman, there being one general foreman for each shift. The general foreman reported to the superintendent, who was located on the work.

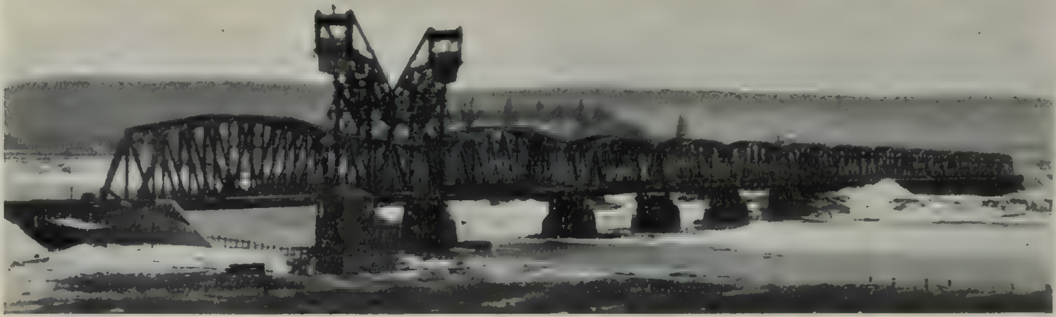
The substructure consists of twelve concrete piers and two abutments all resting on pile foundations. The deepest foundations are at piers No. 1 and No. 2, which were carried 25 ft. below record low water. The average depth of water during the progress of the work was well over 30 feet, requiring 40 ft. steel sheet piles in the cofferdam. Careful soundings taken before the work was started showed gravel with underlying strata of very stiff sandy clay, with layers of quicksand. An exhaustive study was made of the individual pier and abutment sites, and coffer-dams were designed to suit the conditions at each point. Three types of coffer-dams were used—cribs, steel sheet piles and triple lap wooden sheet piles. The coffer-dams were made of sufficient size to allow ample room for the necessary coffer-dam piles, bracing and other timbers. The bracing was spaced to allow of dredging with grab buckets.

Actual work on the shore was commenced in September, 1913, on the east abutment and pier No. 6, the only units then accessible. The temporary bridge, from which all work was directed, was started at this time and carried out as far as navigation laws permtted. Later, when floating ice stopped navigation, it was found difficult to drive the remainder of the bridge, and it was not until January that it was entirely completed. The river, with a current of five to six miles an hour and filled with floating ice, presented a formidable obstruction, not only against the construction of the temporary bridge, but it seriously hindered the construction of coffer-dams.

The general programme of construction for each pier was as follows:

1.—Open dredging was carried as deep as it could be maintained.

2.—The coffer-dams were then built. Where crib coffer-dams were used, they were built and sunk in the ordinary way. For steel coffer-dams, wooden piles


The completed structure.

were driven about 8 ft., centre to centre, around the space to be inclosed. These were carefully lined up and two sets of timbers, 4 ft. apart vertically, bolted on the inside of the piles above water to act as guides for the steel sheeting. Three or four complete sets of waling and bracing were then placed and sunk as deep as possible. The steel sheeting was then set inside the guide timbers, it being driven about 3 ft. as set and the closure made when the last sheet pile was set. After closure, the steel was driven to the full depth required, usually 6 ft. below the elevation required for the bottom of the foundation.

3.—Excavation inside the coffer-dam was continued with dredges, teeth being used on clam-shell buckets when clay was encountered. As far as possible the waling and bracing were sunk as the excavation proceeded. The excavation was usually carried 2 ft. below the bottom elevation required, in order to allow for swell due to driving foundation piles.

4.—When the excavation was completed, the foundation piles were driven and cut off under water by means of a circular saw on the end of a shaft. The penetration of the foundation piling was about 20 ft. below cut-off. The driving was very difficult.

5.—After the foundation piles had been cut off, the concrete was placed under water by means of bottom dump buckets. A 1:2:4 mixture was used. The amount of sealing was figured carefully to prevent floating or "blow-in." The sealing was allowed to set from three to six days, depending on the depth of the water and temperature.

6.—When the concrete was properly set, the coffer-dam was pumped out. As the water was lowered, the bracing was examined, and strengthened or repaired, as necessary. The results in all cases showed first-class masonry.

7.—Forms were built and the pier concreted, using a 1:3:5 mixture and taking precaution against freezing, as described later. Piers 7 to 12 are located in the Nechaco channel. Shortly before these piers were built, an ice jam came down the Nechaco River and filled this channel, which previously had been dry, with broken ice from shore to shore to a minimum depth of 15 ft. In building the temporary bridge to serve these piers, it was necessary to excavate through this ice to get a foundation for the framed bents, which were used to support the bridge. It was also necessary to excavate through the ice before starting coffer-dams for the piers.

To prevent the concrete from freezing, the gravel was heated by means of steam boxes. The water was also heated and the concrete was placed in the forms hot. The forms were entirely covered by tarpaulins extending from the top of the coffer-dam to the top of the forms, completely enclosing the pier. Under the tarpaulins, fires were kept in small stoves, or steam heat was furnished from radiators built on the work. Both methods worked well, but steam was more satisfactory and was used where there was an available supply, as this method avoided the danger of fire from the stoves. Heating was continued for three to seven days after the placing of the last concrete and the forms were stripped in from seven to ten days. The results obtained were remarkable: the masonry is smooth and of a uniform color, and there are no indications that frost penetrated anywhere, **although concrete was actually placed at temperatures as low as 35 deg. below zero and temperatures of 50 deg. below zero were experienced while the concrete was setting.**

For the Fraser Channel, two concrete plants were used—one on the island and one on the east bank. Gravel taken from the river was stored close to the mixer. Cement, which had been delivered by scow, was stored at both plants. Concrete was taken from the mixer to the piers in buckets, on cars handled by an endless cable. Buckets were handled from the cars to the forms by the derricks, which had previously built the coffer-dams and made the excavation. For the Nechaco Channel, gravel was obtained from the foundation for each pier and a mixer was set up at each pier, it being moved as the work progressed.

The weekly progress report used was a white print 28 ins. long, showing an elevation and plan of the bridge and a profile of the river-bed. Concrete progress was marked on the elevation and plan, and coffer-dam and pile foundation on the profile. On the print was a table showing the quantities of excavation, coffer-dam piling and concrete for each pier, the table being filled in each week. In addition to this, a monthly report was made for each pier or abutment, showing the progress, materials used and the condition of the work. These graphic reports were made up at the Superintendent's office and forwarded to the main office in Chicago.

The work on the substructure of this bridge was completed on May 20th, 1914. During the progress of the work, the track had arrived and been carried across the river on a temporary bridge, in the maintenance of which serious difficulty was experienced. After the arrival of track and the installation of train service, the conditions of the work were materially improved as it was possible to get supplies within a relatively short time.

The lift span open. This span is fifty feet above high-water mark.

The fourth crossing of the Fraser consisted of two 250-ft. spans, six 204-ft. spans, four 200-ft. spans, and one 100-ft. drawspan.

The amount of work is seen from the followng quantities: excavation (dry), 3,175 cu. yds.; excavation (wet), 15,986 cu. yds.; foundation piling, 3,000 piles; concrete, 14,576 cu. yds.

The Bates & Rogers Construction Company built some twenty or more bridges between Tete Jaune Cache and Prince Rupert (a distance of seven hundred miles) for the Grand Trunk Pacific Railway. Of these the Fourth Crossing of the Fraser was the largest. This company also enlarged and lined with concrete (heavily reinforced) eleven tunnels for the G. T. P. in Alberta and British Columbia.

A mixture which will permit hard steel or iron to be drilled with ordinary drills is made by using 1 part spirits of camphor and 4 parts turpentine. Mix well and apply cold, letting it remain a few minutes before applying the drill. Run the drill slowly with fine feed.

Position of Great Britain in Steel Trade

In view of the important place taken by iron and steel among trade products the following article which appeared in a recent number of Made in Britain and which deals with the position held by Great Britain and her possibilities for further advancement in the steel trade of the world, should be of interest:—

Change in Relative Positions

Living, as we are, in the steel age, it is perhaps not surprising that the mind instinctively classifies nations according to their relative positions as iron and steel producers and traders. The non-technical man, therefore, on the strength of a tradition that was until recent years acknowledged throughout the world, unhesitatingly places Great Britain first in the list. Thirty years ago that idea would have been quite sound, for then Great Britain was by far the largest iron producer in the world, with an output of nearly 7½ million tons of pig-iron—the raw material of all iron and steel products—compared with some 4,000,000 tons in the United States, about 3,700,000 tons in Germany and 1,500,000 tons in France. To-day, however, this country takes a bad third place, with an output of only 10½ million tons of pig-iron, while the United States leads with about 30 million tons under normally prosperous conditions and Germany takes second place with about 19½ million tons. The production of pig-iron, however, represents only part of the case, so we may examine the next stage—the manufacture of steel in its preliminary or ingot form. Here the position is relatively similar, the United States retaining a hopeless lead and Germany more than doubling our production. In passing, it may be remarked that the growth of the German steel output has been almost phenomenal; it has trebled in about the last fifteen years.

The moral to be drawn from the foregoing facts, however, is not that Great Britain is decadent, as some wise men with a little knowledge would have us believe; the fact is that this country obtained a good start in the matter of industrial progression and the development of natural mineral resources, and placed herself in a position which was not really in keeping with her size, population or resources. America, on the other hand, was a country in practically the infancy of development and it was not then known that her natural resources of coal and iron—the two essentials for a great steel industry—were so immense as to dwarf those of the older countries. We now know that it is vain to dream of competition with America in the matter of quantity of coal and iron output, though that fact, of course, does not discount the importance from a commercial standpoint of the British coal and iron industries. To-day we have, and are likely to retain for very many years, a vast coal-exporting business, amounting in 1914 to 62,000,000 tons, exclusive of 18,500,000 tons shipped as bunkers, while the fact that in the same year we exported 4,000,000 tons of pig-iron and manufactured iron and steel (apart from machinery of all sorts, hardware, etc., and ships), testifies to the hold which we have kept on the world's markets.

When it is recalled that these exports included railway rails and material, plain and shaped bars of a large variety, joists and girders, hoop and strip iron and steel, sheets and plates, tinplates, galvanized sheets, forgings, castings and a variety of other descriptions representing the sale of a large amount of skilled labour and technical knowledge in manufacturing, it will be seen that Great Britain, "though superseded is not useless" in the steel trade.

The Development of the Industry

A fact that is of interest is, that the rise of the German industry has been chiefly due to the technical discovery in the early 'eighties of two Englishmen—Thomas and Gilchrist—who, by the discovery of what is known as the basic process of steel making, rendered valuable and usable the hitherto useless phosphoric ores of Germany. The same process has permitted the economic development of one of the greatest ore fields in Europe—that lying in the Lorraine area and extending into both French and German territory. This fact incidentally explains the rise in the French iron production from about 1½ million tons in 1886 to 5½ million tons in 1913.

Not only has Great Britain given a lead to the world in the inception of the great steel age, but she has been in the front rank in the scientific and technical discoveries that have produced the modern steels on which engineering in all its branches is now dependent. The limitation set by the nature of wrought iron—the chief form of commercial iron in the days before Bessemer astonished the world by his process of producing what is now known as mild steel—rendered the progress of engineering, as we now understand the term, practically impossible. The cost of producing steel by the pre-Bessemer process confined the material to tools and similar appliances, and all stuff for work of any size was preforce a combination of wrought iron and cast iron. To-day we have almost every grade of steel, from mild forgeable qualities suitable for the varied requirements of the structural engineer to the tool steels of glass-scratching hardness which will cut other steels and cast irons at even a red heat—a thing which would have been accounted an extraordinary absurdity a few years ago. British initiative and research is responsible for these developments also.

In the face of these facts there would appear to be no reason for pronouncing the decadence of this country in the great steel industry, nor is there any cause for such a pronouncement in a general sense. The world is continually presenting new fields for the disposal of steel and iron products of every description, from the raw pig-iron and the plain bar of steel to the highly-complex finished machine or locomotive; and Great Britain is still one of the countries to which consumers in these markets first appeal. The years of steady development of plant and machinery, processes and technical skill, cannot be duplicated readily; even the raw materials are handy in a new country. Moreover, many countries (Sweden and Spain are good examples) with ore resources lack fuel resources, with the result that they are rather exporters of raw material to Great Britain and other producers of manufactured goods, than producers themselves.

Shortcomings of British Producers

But despite our present solid position and technical advancement there are some points of vital importance that do not receive proper attention, and neglect in those directions must inevitably lead to a serious disadvantage in international competition. There is too often displayed by British manufacturers an indifference to new demands and a tendency to plod along on the old lines, allowing customers to have certain special requirements met by foreign enterprise. This is not a technical deficiency, it is a commercial laxity. An example recently much discussed is that of certain motor car parts of alloy steels, which have been extensively obtained from abroad, though every requisite of technical skill and plant was available here. The light steel-castings trade affords another example, for British steel founders have lost a good deal of trade to the Continent, simply through inherent conservatism in methods and the application of knowledge which British scientific research has provided.

In purely business matters, too, there have been and still are grave laxities, particularly in the matter of representation in foreign markets, in proper methods of advertising and even in quoting to inquirers in the desired currency and measure. It is quite a common thing to find catalogues, price lists and quotations being sent to Russian inquirers, for example, printed in English, with English weights, measures and currency—a combination which is almost fatal to the success of attempted business with such a country. Representatives with often only the barest smattering of the language, too, are often sent abroad in the interest of important manufacturers. These are a few of the defects of British methods which will go far to determine the future of the country's steel trade; for it essentially must rest largely on foreign demand. No amount of skill in workmanship or quality of product will counterbalance these defects in British methods, and when we find technically competent competitors such as Germany exerting every effort of business organization to meet her foreign customers, it behoves us in the interest of our future stability in the world's markets to set our house in order.

Professional Advertising—Its Scope and Limitations

THE question of advertising always promotes controversy, and opinions on its morality and efficacy vary between the view of the typical commercial traveller, who regards it as a chief necessity of commercial life, and that of the altruist and artist, to whom the very expression is anathema. We shall endeavor to show, firstly, that it is almost impossible for the professional man to make a career for himself without that which, strictly defined, must be classed as advertising; and, secondly, that the abuses of the practice are mainly better dealt with by that most potent of all deterrents, ridicule, than by attempts to draw up codes of ethics and rules.

Advertising may be described as a definite effort to draw attention to the merits of any article with a view to its sale, or to attract notice to the capabilities of a man in order to secure his employment in the present or future.

We will assume the case of an architect who wants to obtain work, but who has neither a private income nor influential friends. If he shuts himself up in his office and waits until clients come he will probably wait during his whole lifetime, for his skill, being unknown, is almost useless as an asset to him. He may, it will be said, take part in public competitions, and so secure work; but, in the first place, though "many are called, few are chosen;" and, secondly, only a certain type of man is fitted for the competition struggle; and there are many good architects who are quite unable to qualify even after long practice for competition winning. Again, our architect may secure an official position, but to do so he usually needs friends and introductions he does not possess. Under such circumstances he will probably join clubs or societies composed of men working together for some object of interest or pleasure, and he will assuredly not hide the fact that he is an architect from those with whom he comes into contact. And if he does so he is advertising himself equally with those who put their names on the hoarding of a building under erection. There may be an objection to the one practice and none to the other, but both alike are inspired with the same object.

There are, too, among practising architects those who, in convenient season, will let individual members of the public know directly or indirectly that they have special knowledge of a certain class of building; that they have made a special study of Italian architecture; that, in their experience, the only way to secure good building is to adopt special methods to eliminate the possibilities of scamped work; or they will tell a friend some interesting detail of the evidence given in a legal case in which they were witnesses. All these things are to be regarded as advertising, and criticism is usually absent if the process has been sufficiently subtle and is not painfully apparent. We have heard of men who are far too busy to be seen except by special appointment, but who have been known to be somewhat less busy than appearances seem to indicate; and should a client offer the busiest of architects a fresh commission he will in not a few cases be found quite willing to accept it.

Apart from the advertising involved in suggesting openly or covertly that one possesses professional qualifications, there is the no less subtle process of "making friends" by being a pleasant companion, or by proving one's use in some outside capacity or other, and our contention is that all these methods are employed in varying degree not by quacks and charlatans, but by everyone who has tact, ambition, and understanding, and that they are natural impulses springing out of the necessities of our existence, and yet that, if analyzed, they are but so many forms of advertising. The English Bar may be quoted, for its etiquette as far as advertising is concerned is unusually strict, but the same general conditions apply. Though a barrister may not approach a solicitor and ask for work, he can indicate in many side channels such as politics, journalism, and public life, his fitness and ability; and the etiquette of the medical profession does not entirely prevent the ambitious younger men from demonstrating their ability in their professional calling.

The broad line beyond which such practices are to be condemned seems to us to be where they injure someone else in the same calling who may be said to be "in possession," and where they contribute to bring the exponents of a calling into low esteem.

An architect we once heard of would call on a friend who had employed someone else, and, the subject being referred to incidentally, would say, "If I had known before! But I must say nothing," and, on being pressed for his meaning, he would, with apparent reluctance, give reasons why his friend would have been better advised to come to him. Sometimes the suggestion worked, and in other cases it did not, but such methods are not calculated to raise individuals, or the callings they are members of, in the public esteem. Nor can anything but utter condemnation be meted out to the man who undermines a rival ation be meted out to the man who undermines a rival by offering to do the work in question for smaller fees, for this is a pure and obvious malpractice which should be put down with the utmost rigour.

But we are always amused at the dictum that it is legitimate and proper to inscribe the architect's name on his work in small and almost illegible lettering, while it is unprofessional that the architect who is erecting a building should have his name placed on a hoarding. "By thy works shall ye be judged," and should the public, whose attention is usually attracted to a building in course of erection, wish to know the name of its architect it seems to us entirely to the advantage of architecture that it should be able to do so, to praise and remember, or condemn and remember, as the case may be.

In most of these matters common sense and decency will prevent that which is objectionable from being efficacious. The architect who obviously pushes for work and presses his claims unduly will fail in his endeavors. It is useless and ridiculous for an architect to advertise his qualifications in a large heading on his notepaper; most people have sufficient sense to recognize that the man who emphasizes his own merits is more in want of work than the man who does not adopt extraordinary means to force himself on the attention of the public, and they will be critical as to his qualifications. Professional men will find that they cannot impose on the credulity of the public by emulating the methods of a vendor of patent medicines; ridicule will kill almost all such attempts more surely than intricate codes of regulations, which give opportunities for much useless debate. If the professional man becomes a bore and a tout he will suffer in pocket as well as reputation by doing so, but the total elimination of such characters—if possible, which we doubt—would deprive fiction of much of its material! The reputation of architects as a whole will not suffer because of the eccentricity or vulgarity of a few individuals the difficulty of controlling whom is hardly worth the labor involved in doing it.

We should not be inclined to go so far as to say that an architect should not in any case ask a friend to employ him; in some cases it can be done without loss of dignity or sacrifice of professional reputation. "Manners makyth man," and the conditions which determine what is good or bad taste in a certain instance are too delicate and complicated to form a basis for rules and regulations. We have heard the statement made that a man can ask for almost anything if he asks for it in the right way, and we think this is very nearly true in life. He who understands men will come to the conclusion that they are moved in different degrees by the same impulses, and that there are few of our natural and normal impulses which cannot be gratified without disadvantage to the community if our methods are well chosen. The need for advertising arises out of civilization, and it is only condemned when it is badly done!—The Builder (London).

Small Contracts and Limited Competition in Road Construction

DIVIDING road construction work into small contracts usually limits competition to local bidders, says Engineering and Contracting editorially in a recent issue. By a small contract is meant one involving less than $10,000. In some exceptional cases it may be desirable so to limit competition. In the majority of cases, however, it is not desirable.

That competition is limited by dividing work into small contracts is a well established fact. The reasons for lack of outside competition under these conditions are obvious. The main reason lies of course in the fact that the amount of work involved in a single contract is not sufficiently large to justify a foreign contractor in moving construction plant any considerable distance or in purchasing plant on the strength of a small job. Also travelling expenses and other expense incident upon the preparation of a bid are frequently a large item in small contracts. The redeeming feature of limited competition, if there is such a feature, is the fact that contractors of limited means are able to bid upon the work and the work is secured by contractors familiar with local labor conditions and local material and by men well known to the engineer-in-charge of the work. There is a question, however, whether the work is accomplished as economically when competiion is limited or when more bids are received.

The method of advertising for bids also has a bearing upon the number of contractors bidding upon work. When contracts are small and are let at intervals through the construction season it is frequently thought unnecessary to publish the time of letting in other than the local newspaper. The limited extent to which these papers reach contractors undoubtedly affects competition. With larger contracts it is the general practice of progressive engineers to reach as large a number of contractors as possible by means of advertisements in the engineering journals.

The condition may be relieved somewhat by so grouping the small contracts and receiving bids at the same time that a contractor may bid on several contiguous sections of road. Even under this system, however, uncertainty exists with regard to securing contracts on a continuous section of road, and the danger of having work thus chopped up frequently discourages such bids. Moreover many specifications do not permit a contractor to modify the form of the proposal so as to make the price bid upon several sections of road contingent upon the awarding of them all to one bidder. High bids upon each section result under these conditions.

We believe it to be a much more satisfactory practice both from the standpoint of the engineer and contractor to let construction work in large contracts. Contractors with small capital may then take subcontracts and may so choose their work that it fits the plant they possess. The clerical work of the engineer is reduced materially and he is assured of the ultimate and timely completion of all the work in hand.

The steel work for the "Tower of Jewel," of the Panama-Pacific International Exposition, has been completed. The placing of the highest steel column makes the top 435 feet above the ground. More than 1,500 tons of steel have been used in the frame and 1,600,000 feet of lumber will be used in completing the structure.

The C. P. R. Lachine Canal Bridge

By the reconstruction of their bridge over the Lachine Canal, the C. P. R. have been able to double-track the last section of single track between Montreal and Brigham Junction, beyond Farnham, P.Q. The work of reconstruction was carried out day and night, and without interruption to the usual traffic. Operations on the sub-structure were commenced on December 1, 1914, the bridge seats were ready to receive the steel girders on February 8, and the double-tracking was put into service several days ago. The work was designed by Mr. P. B. Motley, Engineer of Bridges for the C. P. R., whose object was to design a double-track swing bridge in such a manner as to utilize, after enlargement, the old pivot pier of the original bridge, accommodating two tracks instead of one by the use of four deck plate girders instead of the original lattice truss construction, with the traffic running, as it were, through the bridge. This plate girder swing span is 239 ft. 7 ins. long and 13 ft. 6½ ins. deep in the centre, reduced to 8 ft. 0½ in. at the ends measured from back to back of flange angles. Two girders were erected on the upstream of the old bridge sufficient to carry traffic while the downstream side was altered, and the other two girders erected and connected up with lateral and other bracing.

The four girders, each of which weighs 112 tons, were shipped in three pieces from the Dominion Bridge Company's shops and were lowered into place by heavy derricks. When all the parts had been accurately assembled, they were riveted into their complete lengths, after which the operating machinery was installed. The weight of the whole swing span is 615 tons, while a 90-foot span weighing about 143 tons at the south of the bridge replaces the old 40-foot deck plate girder span and accommodates the existing roadway, and admits of the running of a future railway track along the south canal bank, if necessary.

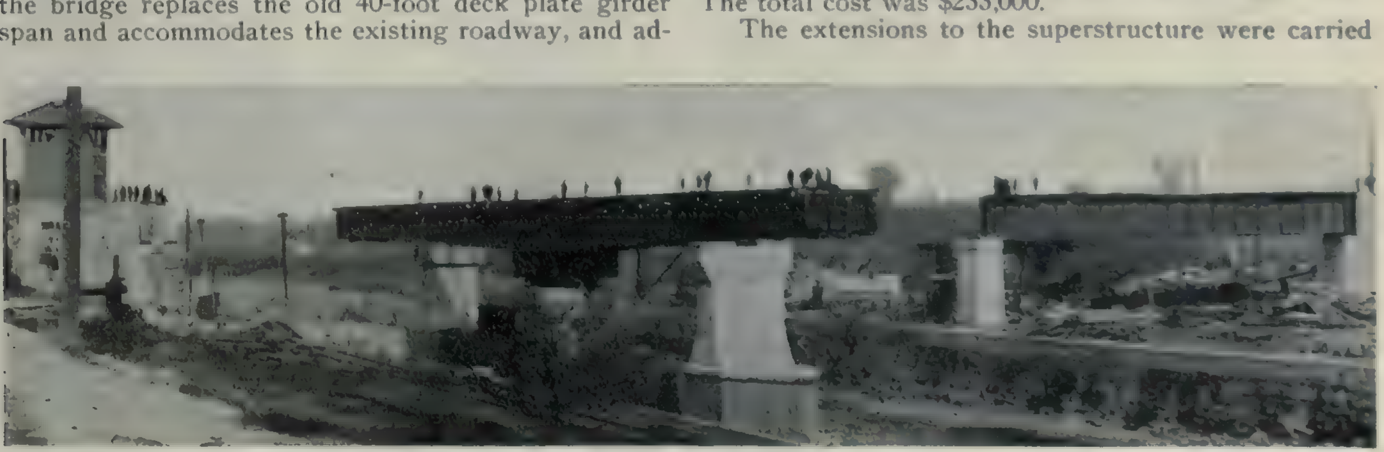
The new bridge is operated by electricity, the power being carried by cables under the canal to the centre pier, and there supplied through duplex 30 h.p. motors controlled from the operator's fireproof house on the north bank of the canal, where a special 30 h.p. motor is kept on hand for emergencies.

The work accomplished since December 1st includes the demolishing of the old single track abutments, the building of a new double track abutment, the widening of the earth embankment, the extension of two piers—one of which entailed considerable subaqueous work and bonding into the old stonework—and the extension of the old north abutment to accommodate the double track and also to act as the lower storey for the operator's house.

The bridge is protected by the most modern interlocking machinery, so as to make it impossible for a train to approach the bridge before it is properly closed and safely locked, and, in addition, it is impossible for the operator to open the bridge for canal traffic until all railway traffic is stopped at a safe distance from the bridge. All of these operations are controlled from the operator's house, which commands a view up and down the canal, even when trains are passing over the bridge. The new type of bridge likewise gives a much clearer view along the track than formerly, as there is no overhead lattice work projecting above the rail level.

The structure is also provided with a system of lights, as required by the Board of Railway Commissioners, for the protection of shipping on the canal. The total cost was $233,000.

The extensions to the superstructure were carried



Rebuilding the C. P. R. bridge over the Lachine Canal.

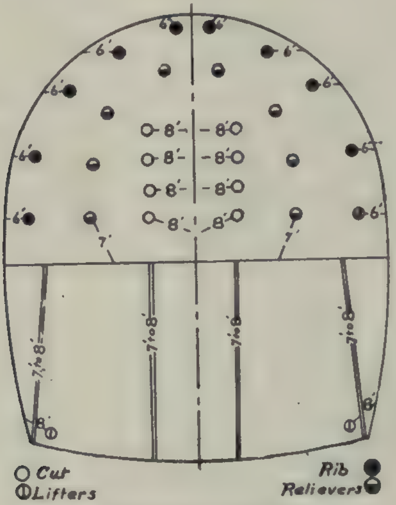
out by the John S. Metcalf Company, Limited, Montreal, and the steel work was manufactured and erected by The Dominion Bridge Company.

Tunnel Driving Record on Passaic Valley Sewer

Five Hundred and Forty-One Feet Advance During March Believed to Break the World's Record.

A new world's record for tunnel driving is said to have been established last month by Robert E. Parker, superintendent for the New York and New Jersey Construction Company, at the heading from the Newark shaft, Section 3, of the Passaic Valley trunk sewer, this tunnel having been advanced 541 feet during March. The previous record was 521 feet completed in one month, this having been accomplished by Charles Marion, shaft superintendent for the Degnon Contracting Company, at Shaft 3, contract 47 of the Catskill aqueduct, at Forest Glen, N.Y.

On March 1st at 8 a.m. the tunnel heading referred to had reached station 92+47.1; at 8 a.m. April 1st the heading was at station 87+06.25, making the distance for the month 540.85 feet. The bench had advanced during the same time 541.00 feet, an average of 540.92 lineal feet of completed tunnel. The actual working time was 37 1/3 days of three shifts each, or 82 eight-hour shifts of both drill runners and muckers.



Location of drill holes in tunnel heading.

Four Ingersoll-Leyner drills swung from two columns were used in the heading, drilling eight 8-foot cut holes, eight 7-foot relievers and ten 6-foot trim holes, a total of 26 holes. In the bench two Butterfly Jap drills were used to drill four bench holes 7 to 8 feet long and two lifters 8 feet long, a total of six holes, making a grand total of 32 holes per round of tunnel. Five changes of steel were made for each hole, beginning with a two-foot "starter," then four, six, eight and ten-foot respectively. The average daily progress was 19.75 lineal feet and the yardage 6.6 cubic yards per foot. The locations of these holes are shown on the accompanying diagram, the cut holes inclined toward the centre, the relievers parallel to the tunnel line, and the rib or trim holes inclined toward the outside of the tunnel.

To handle and remove the rock after the shots, three shifts of muckers are necessary, and as the heading is approximately 2,000 feet distant from the shaft, the muckers load the rock into cars, and it is then hauled by electric locomotives of the storage battery type to the shaft, two or three cars at a time, whence it is loaded on the cages or elevators, of which there are two running alternately, lifted 264 feet to the surface, and dumped into bins by the tipple method.

A rather unusual feature of this stretch of record tunnel is the fact that it is driven to line and grade, clean cut, thereby necessitating a minimum of trimming later on. No particular effort was made to break the previous record, as it is the policy of R. H. Keays, engineer in charge of the N. Y. & N. J. Construction Company (under whose direct supervision the work is being carried on) to sacrifice speed to the safety and welfare of the employees. If such precautions had not been taken, a still greater distance could have been made.—Municipal Journal.

Activated Sludge in Sewage Oxidation

EVEN at the summit of popularity of the septic tank, those who were familiar with sewage treatment processes did not lose sight of the fact that in septic sludge and septic effluent the organic matter was not rendered finally nonputrescible; but it has always been believed that in oxidation lay practically the only means of really purifying sewage.

Oxidation can be effected by adding chemicals which carry large amounts of oxygen which they yield readily; but for treating sewage by the millions of gallons this is too expensive a method to be considered. Dilution with large volumes of water carrying considerable free oxygen is a common method; but sufficient water high enough in free oxygen is not always available, and other uses of the water may be interfered with before the oxidation has been completed.

Air has always seemed the cheapest and almost ideal source of oxygen for this purpose, but a simple mixing of air with sewage accomplishes little. The intermittent filter is a method of mixing air and sewage in the presence of bacteria which seem to be necessary for rapid oxidation of nitrogenous matter, and which develop and remain on the filter particles continuously. Some other forms of plant life have the power of performing or facilitating oxidation when oxygen is present.

Recently English experimenters have learned that if a sewage sludge be kept continuously mixed with air, there develop in it some animal or vegetable organisms—probably both—which effect rapid oxidation of nitrogenous matter in sewage, and by mixing such "activated" sludge with sewage in the presence of abundant oxygen for three to six hours a high degree of nitrification may be obtained. This method and some of the history of the experiments which have been made in developing it are described elsewhere in this issue.

Assuming all the results which have been announced to be correct and correctly interpreted, there remains the question as to the practicability of the process. Are there any difficulties in applying it in practice which will make it too complicated or too expensive for general use? The physical apparatus required would appear to consist of a tank provided with means for supplying air in an effective manner, and means for keeping the sludge and sewage constantly mixed and withdrawing the liquid without removing any of the sludge with it. Also—and this must not be overlooked—it is believed that the temperature of air and sewage should not fall much below 50 deg. Fahrenheit.

But if this air must be kept up to 50 deg. temperature, it must be heated in winter. The cost of heating 1,000,000 cubic feet of air from, say, 30 deg. to 50 deg. for each million gallons of sewage would be quite an item, but would apparently be necessary in northern climates. Several experimental plants—one or two of good size—involving heating the air which is applied to contact filters and similar plants have been constructed in England, but we believe that the idea was abandoned, the improved results not justifying the cost. Possibly it may be found that this heating will not be necessary, given sewage of ordinary temperatures; but the volume of air used is so great that this now seems improbable.

It is to be hoped that some way will be found to operate the process in continuous-flow tanks, rather than in a fill-blow-settle-empty cycle; for the former will require less head, less capacity of tank and less labor or mechanism for operating. Plans are now under way to experiment in this line at the Baltimore, Md., sewage treatment plant.—Municipal Journal.

Gasoline Vapor in Sewers

Tests of air in Boston's sewers to determine whether gasoline vapor was present were made recently by Arthur D. Little, Inc., using an apparatus with some novel features. This consisted of a long rubber sampling tube and aspirator connected to the inlet cock of a priming spark plug of the usual automobile type. The sample is taken in a rubber balloon, which is first collapsed and slipped over the end of the spark plug. The pipe is first purged out to insure that the sample is representative. The balloon is then inflated with the sample, a spark is made at the plug terminals, and if gasoline vapor is present from 1.1 per cent. up to a mixture too rich to explode, a sharp explosion occurs. If, after testing several samples, no explosion is obtained, it may be regarded as certain that there is not 1.1 per cent. of gasoline vapor present. The inflammability of the gas in the bag should not be tested until it has been removed to a point where the flame would not reach the sewer air; otherwise an explosion in the sewer itself may be caused. This appliance obviates the necessity of returning to the laboratory to make each test.

Hot irons instead of brushes are used in spreading joint fillers over the top of wood-block pavements now being laid on Main Street, Kansas City. Four irons are provided, two being heated while the other two are in use. Clark R. Mandigo, Assistant City Engineer, states that the filler penetrates the joints quickly at the point where it is spilled from the cans, but when pushed any distance by brushes the thin layer cools rapidly and the increased viscosity keeps it on the surface. The hot iron squeegee increases the fluidity, thereby insuring an even penetration. Blocks are laid on a cement grout cushion, 1:4 mix, to prevent shifting.

Sand for the filters at Moline and Rock Island, Ill., is obtained from the Mississippi River by a centrifugal sand pump on a boat. Barges are unloaded at the dock into the river by a stream of water from the sand pump. From the river the sand is pumped again to the bins. "So much handling by water thoroughly washes the sand," said L. A. Fritze, city chemist of Moline, at the meeting of the Illinois Section of the American Waterworks Association. The raw product has an effective size of 0.28 mm. and a uniformity coefficient of 2.11. By washing off the fine sand after placing in the filters the size is increased to 0.51 mm. and the uniformity coefficient reduced to 1.34. Nine inches of large-sized gravel, 2 in. and over, placed under the regulation layer with from ¾ to ¼-in. sizes, made the operation more satisfactory. In six months there were no packing or strainer troubles. The river sand ready for service costs $1.47 per cubic yard.

The Buildings of a Great City Classified

There is a total of 375,037 buildings in New York City, according to the New York "Times," apportioned as follows: Manhattan, 84,849; Bronx, 35,163; Brooklyn, 172,380; Queens, 62,525; and Richmond, 20,120. Brooklyn has more one- and two-family dwellings than any of the other boroughs, 62,080 and 49,505 respectively, and the most tenements without elevators, 45,956. Manhattan has 2,155 elevator apartment houses and hotels, as compared with 70 for the Bronx, 209 for Brooklyn, 231 for Queens, and 82 for Richmond. Manhattan has 813 office buildings, as against 69 for the Bronx, 145 for Brooklyn, 95 for Queens, and 47 for Richmond. Brooklyn leads in factories, with 2,364, whereas Manhattan has 1,428, Bronx 250, Queens 621, and Richmond 627. Manhattan has 7,964 warehouses, loft buildings, and department stores, as compared to 1,551 for Brooklyn, Bronx 142, Queens 40, and Richmond 85. There are 229 theatres, not including moving picture theatres, in all the boroughs, of which Manhattan leads with 128, Brooklyn 68, Bronx 12, Queens 18, and Richmond 3.

The facts that the New Brunswick Government has been enabled to complete a large section of the Valley Railway during the past year, and that it has also been able to issue bonds to retire indebtedness outstanding and falling due at a better rate than some other Canadian cities or provinces, speaks well for the general condition of New Brunswick finance. At the commencement of 1915 the Intercolonial Railway assumed the working of 120 miles of the Valley Railway, and trains are now running over between 80 and 90 miles of the section; a regular service is also expected to be shortly commenced upon the balance of the new mileage ready for working.

Six types of reinforced concrete fence posts have been tested under the direction of the committee on signs, fences and crossings of the American Railway Engineering Association. All posts were made of 1:2:4 concrete, using broken stone or gravel aggregate not more than ½ in. in size, and were about one year old when tested. Two round, one square, one half-round, one T-shaped, one triangular section were used, all 7 ft. long, all of tapering outline except the last. The reinforcement consisted of various sizes of steel wire or rods, and the lateral dimensions varied from 5 to 6½ ins. at the base to 3 or 4½ ins. at the top. Impact, cross-bending and cantilever bending tests were made. The best results in all cases were given by the round tapering post 5½ ins. in diameter at the base and 4 ins. in diameter at the top, reinforced with six No. 8 wires. The other smaller circular post reinforced with five wires also gave very good results. The tests indicated that this form of post, with several reinforcing wires, or the T-form with three ¼-in. rods, was the strongest and most reliable.

Edmonton's Tunnel Sewer System: Features of Design and Construction*

By A. J. Latornell†

THE city of Edmonton, the capital of the Province of Alberta, is situated on both sides of the north branch of the Saskatchewan River. The portion on the south side was formerly the city of Strathcona. In February, 1912, it was amalgamated with the city of Edmonton on the north side, forming the city of Greater Edmonton, now generally known as Edmonton. This paper deals only with sewers serving territory on the north side of the river.

The Saskatchewan River at Edmonton varies in width from about 400 feet at low water, to about 650 feet at flood. The variation in level between low and high water is about 15 feet, but on the occasions of one of two extreme floods it has been 30 feet. The flow at low water is about 1,200 cu. ft. per second, and at average high water 50,000 cu. ft. per second. Low water elevation is 54 (city datum), which datum is taken at 2,000 ft. above sea level. The greater part of the city lies on a plateau at elevation 200 to 260, i.e., from 146 to 206 feet above the river at low water. A small area lies on the river flats at about 34 feet above low water level.

When the system of sewers described in this paper was designed, the area of the city was 9,600 acres, of which 8,500 was on the upper plateau, and 1,100 on the river flats. The inhabited area was served by three sewerage systems:—

(1) The Saskatchewan Avenue system discharging into the river at Saskatchewan Avenue.

(2) The Eastern system discharging into the river at the north end of Frasers Flats (now Riverdale). This served the main business area of the city.

(3) The Rat Creek system, discharging into the bed of Rat Creek at a point about two miles from its outlet. From the discharge point the sewage flowed down the bed of the creek to the river as an open sewer.

The above systems serve an area of about 2,350 acres. The first two were installed when Edmonton was a town, and were extended from time to time to serve additional territory without much regard for adequate depth or overtaxing their capacity. The third, or Rat Creek system, was designed in 1905 to serve an area which could not be reached by the other systems. As the creek into which it discharged was dry during eight or nine months of the year, apart from the sewage flow, the resulting unsanitary conditions were far from satisfactory. In 1909 this system, although of recent design, had almost reached the limit of possible extension, and the two earlier systems had reached theirs. Increasing demands made it imperative to take up the whole sewerage problem, coupled with that of sewage disposal. As a preliminary, the season of 1909 was spent in taking levels and collecting the data necessary for a comprehensive scheme. In the spring of 1910 Mr. Alexander Potter, of New York, was called in as Consulting Engineer, and the design was made under his supervision.

The following are the considerations which led Mr. Potter to adopt a tunnel system of main sewers for Edmonton were:—

(1) The height of the plateau above the river.

(2) Favorable ground for tunnelling.

(3) That steeper grades and consequently smaller sewers could be adopted, than would have been the case if the economical depth for open trenching had been adhered to.

(4) The greater flexibility in the resulting system. of materials becomes important. The possible materials are brick, plain concrete in place, reinforced concrete in place, and reinforced concrete blocks.

Plain concrete was rejected owing to the difficulty of making it of sufficient strength to withstand internal pressure, and to the difficulty of construction, especially in the smaller sizes.

Brick, although very desirable as regards facility of construction, is open to the same objection as plain concrete in its inability to withstand internal pressure.

Reinforced concrete in place would be able to withstand internal pressure if constructed properly, but it was thought that the difficulties of construction would prevent it from being the most efficient or economical material to adopt. To satisfy public opinion, and to verify the above judgment, alternative tenders using reinforced concrete blocks, and reinforced concrete built in place, were invited. For the larger sized sewers the prices were practically the same, but for all other sizes the reinforced concrete blocks were the cheaper. The cross-sections of the reinforced concrete built in place, on which tenders were received, were designed for the same external loads and internal pressure as the reinforced concrete blocks.

Reinforced concrete blocks were adopted, and fulfilled all the necessary requirements. Being essentially a unit form of construction each unit can be inspected carefully before being assembled in the work and, if defective, can be rejected at a minimum loss. There is thus no hesitation about rejecting a unit of doubtful fitness. In the case of reinforced concrete built in place, defects are not always easy to observe, and many which are not considered bad enough to justify the tearing down and replacing of the work, are patched and repaired.

Other advantages of the type of sewer adopted are well summed up in a report made by Mr. Walter J. Francis, of Montreal, for the City Commissioners, prior to the letting of contracts Nos. 3 to 8, and after much of this type included in contracts Nos. 1 and 2 had been already built. Mr. Francis writes in this report:—

"All the materials in which structural strength is concerned, with the exception of the mortar, are complete and perfect above ground. The mortar is composed only of sand and tested cement, and, while it constitutes a very important element, it is easily controlled. It forms but a small proportion of the whole mass and of the exposed face. Consequently in the blockwork types there is a high degree of insurance even before erection. This is a very important matter. In the case of concrete blocks there is no comparison between the ease with which small units of a hundred pounds or so can be thoroughly well made and the care required to make a large mass uniformly dense and homogeneous. This fact is often used in arguing that laboratory tests on such pieces should not be a criterion for settling the permissible unit stresses in larger masses, because of their invariable excellence of quality. This is so in spite of equally favorable conditions of depositing in the moulds, and it must be remembered that the conditions of making the small units in a factory are ideal, whereas the freshly mixed concrete has generally to be put into place under less favorable circumstances and often under severe handicaps. The vitrified blocks are, of course, of full strength as a result of manufacture.

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* Copious extracts from a paper read before The Canadian Society of Civil Engineers on April 8.

† City Engineer of Edmonton.

"The placing of the blocks and the steel in the work is a simple matter, requiring nothing beyond ordinary skill and care. Without difficulty the construction of the permanent work may be carried up close to the heading. Once in position the blocks form no obstruction to the removal of the excavation, or to the conduct of the rest of the work. As soon as it is in position the structural ring possesses a very considerable initial strength, since the only new part of it is the mortar, which, being rich in cement and in small joints only, sets up rapidly.

"The element of early compressive strength of the blockwork ring is of immense importance since it enables the structure at an early age to resist forces due to the uncontrollable dropping or settlement of the earth outside it. The tensile strength cannot be brought into action until after the structure will have been completed, by which time the mortar will have attained such strength that the composite structure will act as a unit.

"No better proof can be had of the practicability of the reinforced blockwork design for your conditions than the fact that it is being put in every day with great facility in your own work.

"That it can safely withstand the internal pressure of the earth is proven by the excellent conditions of the thousands of feet already done by Mr. Manders. Notwithstanding its comparative newness it has resisted all the pressure that has come upon it from outside.

"That it is able to resist any possible internal pressure is a mere matter of calculation. The steel, according to the principles of the design, is proportioned so that the maximum stresses that can be set up in the metal are less than its elastic limit."

The form of reinforced block type adopted is shown in Fig. 2. The sewer is made of blocks maunfactured specially for the purpose, and for that particular sewer. Surrounding the blocks, and lying between them and the earthen walls of the tunnel, is a layer of about 4 inches of mass concrete

The reinforcement consists of circumferential square twisted bars within the concrete or mortar which forms the circumferential joints of the sewer, and of longitudinal straps tying the blocks together in a solid unit. This reinforcement is designed to resist the external pressure on the sewer.

As these sewers are at depths below the surface varying from 50 to 100 feet, they may be subjected to considerable internal pressure when the area is fully built up. Steel reinforcement, in the form of flat bands around the outside of the blocks, is added to resist this pressure. Each circumferential band is made in two pieces joined by coupling shoes of special design. The Textonius lug shown in Fig. 1, superseded these on the greater part of the work. Thorough test showed that this lug was equally reliable, and cheaper than the original design. The coupling shoes or lugs served to join the halves of the bands and to draw them up tight. The bands are designed to withstand the maximum hydrostatic or internal pressure, using a unit stress not exceeding the elastic limit of the steel. The provision of this reinforcement for internal pressure ignores the resistance of the clay walls around the sewer, which in most of the ground through which the tunnels pass would be sufficient provision against any probable internal pressure. The bands are also efficient under normal conditions, and enable less steel to be used in the concrete blocks than would be required if the bands were absent.

The design of the cross-section of the various sizes of sewer is shown in Fig. 2. Two alternative cross-sections were designed for use in bad ground, the choice being left to the City Engineer. These alternatives for the 4-ft., 4-ft. 6-in., 5-ft. and 6-ft. sewers, as prepared for the letting of contract No. 6, are shown in Fig. 2, and those for other sizes are similar. The one with the flat base was used in wet sand or soft ground.

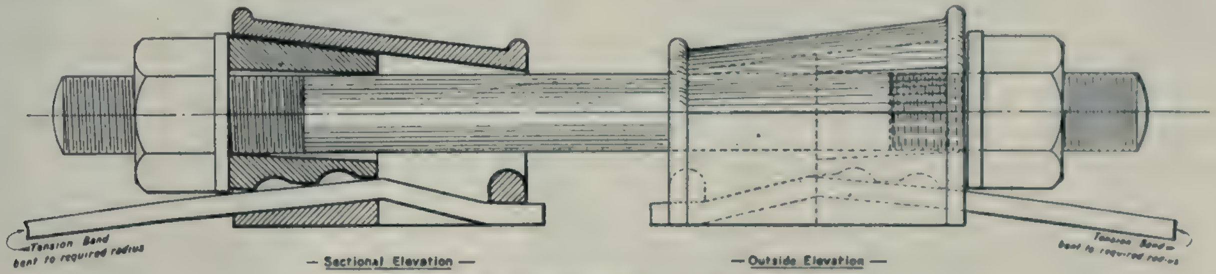


Fig. 1—Textonius lugs as used on tension bands.

In addition to the above types, tenders were also invited on a vitrified block type of sewer. This is identical in many ways with the reinforced block type, the same enveloping concrete backing, and circumferential reinforcement against internal pressure being used. The blocks themselves were depended on to resist external pressure, no steel reinforcement being used. The blocks were to be made by the American Sewer Pipe Company, and atlhough no such sewers were built at that time, some excellent 30, 36, and 42-inch sewers have been built of this material in Edmonton during the past two years.

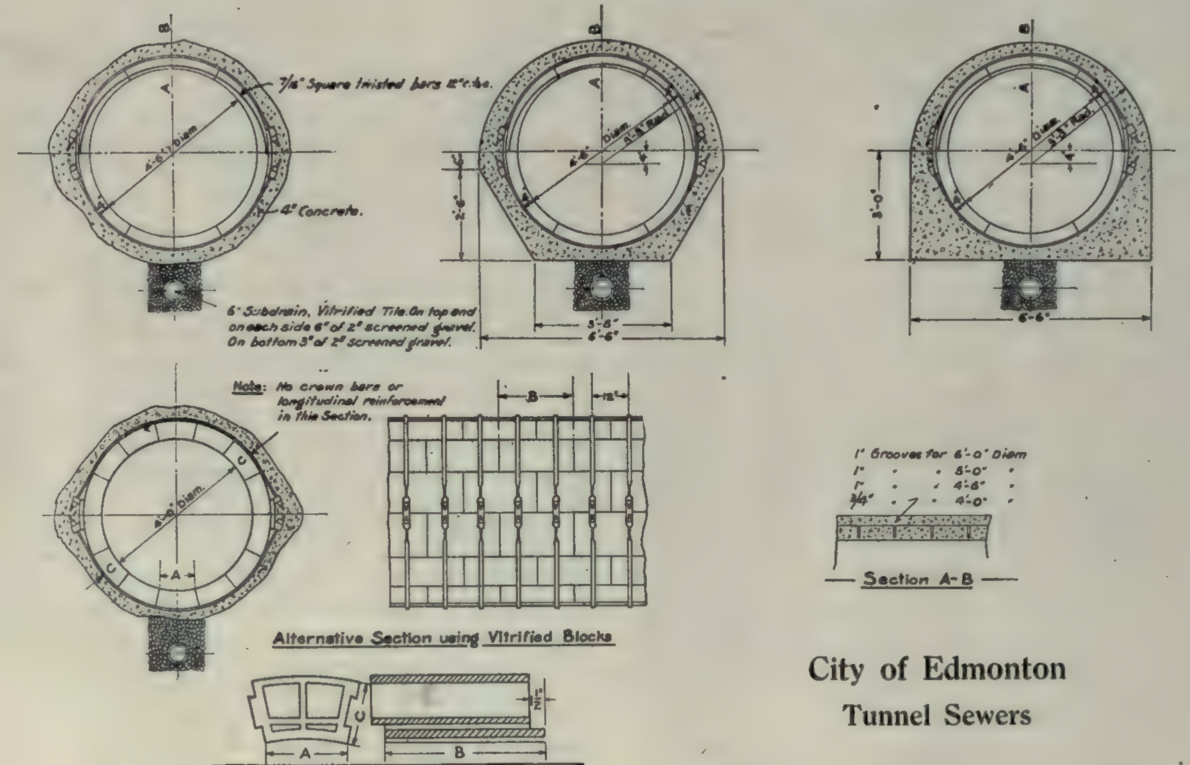
Outfall.—The 10-ft. 6-in. sewer ends near the river in an open rectangular conduit, the latter being intended to conduct the storm overflow to the river. The dry weather, or sanitary flow, will be tapped off in two lines of cast iron pipe and taken to the disposal plant when the latter is built. The bottom of the open rectangular conduit is in the form of steps. The entire outfall structure is of reinforced concrete. As part of this structure is below high-water mark, it would be liable to damage from logs or other floating material during high stages of the river, and to damage from ice jams in the spring.

Tender Price and Cost.—In the tables on the next page there are given the accepted tender price per lineal foot for the reinforced concrete block, and also the lowest tender for the alternative types, namely, reinforced concrete in place, vitrified block, using the ordinary block as manufactured by the American Sewer Pipe Company, and a special vitrified block to be manufactured and supplied by the same company. It will be noted that the ordinary vitrified block is slightly the lowest in each case. However, as it was then a new material, especially in sewers of this size, it was not thought advisable to substitute it for the reinforced concrete block, since at that time the latter had been well tried out in contracts 1 and 2, which had been let some time previously, and were then well under way. The prices given in the table for the alternative types are the lowest tender received. In this way the table gives a comparison of the lowest tenders on each type of sewer. The name of the contractor submitting the lowest tender in each case is also given. The table also shows the estimated cost of each contract made up from the accepted tender. This cost includes cost of sewer of all sizes in this particular contract, as well as the cost of the manholes. The awarding of the contracts was based on these estimated total costs as made up from the tenders submitted by the contractors. This was considered to be the fair basis, as in one or two cases the contractor who tendered lowest per lineal foot had a price on his manholes such that he was not the lowest in the total amount of his bid. The contracts were arranged according to territory rather than according to sizes.

Contract No. 1 was let in June, 1911, contractors from Winnipeg, Edmonton and Regina bidding. Contract No. 2 was awarded in June, 1912, only one bid being received. Contracts No. 3 to 8 were awarded April and March, 1913, bids being received from contractors in Edmonton, Winnipeg, Toronto, Chicago, Seattle, San Francisco and Vancouver. Slight variations in the bids on the same size of sewers are due sometimes to slight differences of location, or more often to the fact mentioned above that awards were made on estimated total costs as obtained from bids, rather than on lineal foot price. It often so happened that a price slightly high on one size in a contract was more than balanced by the low price on some other size included in this contract, or by the lower price on the manholes. Probably the variations in the prices on the 10-ft. 6-in., 9-ft. 6-in. and 8-foot will attract the reader's attention. The variation in the first two is explained by the fact that the contractors, Messrs. Manders & Gregory, who were awarded the contract No. 1, were very much below all other tenders, and in carrying out the contract encountered a good deal worse gorund than the borings indicated. This experience, no doubt, caused them to raise their bid on the 9-ft. 6-in. sewer, which adjoined their first contract.

This company's low bid on the 8-ft. sewer constructed by them, and which was let in the same contract as the 9-ft. 6-in. sewer, is not explained so easily, as this company on the last contract bid higher than McGarry & Company on the same size of sewer. It is true that the ground on the 8-ft. sewer carried out by Manders & Gregory was all first class, whereas McGarry & Company encountered some wet sand.

Prior to calling for tenders, borings were taken at intervals about 1,500 feet apart along the line of the sewer. The log of these borings was supplied to the contractors as a guide in making up their bid. As the bad spots occurred in pockets, many of these were missed by the borings, the most noticeable example be-


B
A
7/16" Square twisted bars 12" c. to c.
4'-6" Diam.
4" Concrete.
6" Subdrain, Vitrified Tile. On top and on each side 6" of 2" screened gravel. On bottom 3" of 2" screened gravel.
Diam.
Rad.
3'-6"
6'-6"
3'-0"
Note: No crown bars or longitudinal reinforcement in this Section.
Diam.
A
C
B
12"
1" Grooves for 6'-0" Diam
1" " " 5'-0" "
1" " " 4'-6" "
3/4" " " 4'-0" "
Section A-B
Alternative Section using Vitrified Blocks
1 1/2"

Diam.	Number of Blocks per Ring	Dimensions			Weight of Block lbs.
		A	B	C	
4' 0"	14	10 1/2"	24"	6"	32 1/2"
4' 6"	16	10 1/2"	24"	6"	34"
5' 0"	16	11 1/2"	24"	7 1/4"	39 1/2"
6' 0"	18	12 1/8"	24"	7 1/2"	42"

City of Edmonton

Tunnel Sewers

Fig. 2—Cross section of various sizes of sewer; also alternative cross sections.

CITY OF EDMONTON — TUNNEL SEWERS — COST SHEET

TABULATION OF TENDERS PER LINEAL FOOT OF SEWER COMPLETE FOR DIFFERENT SECTIONS.

Contract Number	Name of Contractor	4'-0" Diam				4'-6"				5'-0"				6'-0"				6'-6"				8'-0"				9'-6"				10'-6"			
		Reinforced Concrete Block	Special Vitrified Block	Ordinary Vitrified Block	Reinforced Concrete Section	Reinforced Concrete Block	Special Vitrified Block	Ordinary Vitrified Block	Reinforced Concrete Section	Reinforced Concrete Block	Special Vitrified Block	Ordinary Vitrified Block	Reinforced Concrete Section	Reinforced Concrete Block	Special Vitrified Block	Ordinary Vitrified Block	Reinforced Concrete Section	Reinforced Concrete Block	Special Vitrified Block	Ordinary Vitrified Block	Reinforced Concrete Section	Reinforced Concrete Block	Special Vitrified Block	Ordinary Vitrified Block	Reinforced Concrete Section	Reinforced Concrete Block	Special Vitrified Block	Ordinary Vitrified Block	Reinforced Concrete Section	Reinforced Concrete Block	Special Vitrified Block	Ordinary Vitrified Block	Reinforced Concrete Section
1	a Manders & Gregory	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$ 50.36	$	$	$ 47.88
2	a Manders & Gregory																					42.49				55.15							
2a	a Manders & Gregory					22.93																											
3	a Manders & Gregory		24.46	22.44														41.36	44.36	39.00	48.45	51.88	55.37	46.17									
3	b D. McGarry & Co				27.50																				62.00								
3	c Lyall Mitchell Co	24.25																															
4	a Lyall Mitchell Co	24.25	25.25	23.00	27.80																												
5	a H.C. Ulen Co									29.90	30.75	29.00		35.90	38.90	36.90																	
5	b D. McGarry & Co												39.00				43.80																
5	c Manders & Gregory					25.25	26.43																										
5	d Lyall Mitchell Co							24.80	31.00																								
6	a Lyall Mitchell Co	24.25				25.25	27.00	24.80	31.00					36.80																			
6	b H.C. Ulen Co									29.90	31.86	29.00			38.90	35.90																	
6	c D. McGarry & Co				27.80								36.00				43.80																
6	d Manders & Gregory		24.68	22.66																													
7	a Lyall Mitchell Co	24.25		23.00	27.80					30.60	32.25																						
7	b Manders & Gregory		24.68									29.48	37.80																				
8	a H.C. Ulen Co	24.90								29.90	31.86	29.00		36.90	38.90	35.90																	
8	b Hulbert & Wilson												34.45				40.60																
8	c Manders & Gregory		25.68	23.68																													
8	d Lyall Mitchell Co				27.80																												

DETAILS OF TENDERED PRICES TO MAKE UP TOTAL COST PER LINEAL FOOT OF SEWER REINFORCED CONCRETE BLOCK SECTION

Item	Contract No. 1	Contract No. 2		Contract No. 2a	Contract No. 3			Contract No. 4	Contract No. 5			Contract No. 6				Contract No. 7		Contract No. 8		
	10'6" Diam.	9'6"	8'0"	4'6"	8'0"	6'6"	4'0"	4'0"	6'0"	5'0"	4'6"	6'0"	5'0"	4'6"	4'0"	5'0"	4'0"	6'0"	5'0"	4'0"
Excavation in Tunnel per lineal foot	$ {11.00}	$ {17.35}	$ {13.90}	$ {6.90}	$ 18.50	$ 15.50	$ 9.75	$ 6.35	$ 9.25	$ 7.50	$ 6.55	$ 9.00	$ 8.00	$ 6.00	$ 6.35	$ 8.00	$ 6.35	$ 9.25	$ 7.50	$ 6.75
Providing and placing timbering " "					1.00	1.00	.75	2.00	1.50	1.25	1.00	2.50	2.00	2.00	2.00	2.00	2.00	1.50	1.25	1.00
Casting Surplus to Spoil bank " "					3.50	2.50	1.15	1.50	1.60	.90	.60	2.50	2.00	1.25	1.50	2.00	1.50	1.50	.50	.60
Concrete blocks per lineal foot of sewer	{16.75}	{16.40}	{11.60}	{3.40	12.00	8.50	3.95	4.50	8.50	6.50	6.15	8.50	6.50	5.00	4.50	6.50	4.50	8.50	6.80	5.60
Jointing the above " " "				2.00}	3.60	3.00	1.90	1.00	2.85	2.00	2.00	2.00	1.50	1.00	1.00	1.50	1.00	2.85	2.20	2.20
Concrete backing to blocks " " "	8.62	8.40	8.84	3.60	6.60	[illegible]	3.60	4.50	5.00	4.05	3.70	6.00	5.00	5.00	4.50	5.00	4.50	5.00	4.00	3.40
Steel reinforcement including coupling shoe and bending bars per lineal foot	{13.99}	{13.00}	{10.15}	{7.03}	7.35	5.70	3.75	3.40	7.40	7.00	6.00	5.00	4.50	4.00	3.40	4.60	3.40	7.40	6.90	5.00
Providing and laying sub-drains per lin foot					.80	.80	.60	1.00	.90	.70	.70	1.00	1.00	1.00	1.00	1.00	1.00	.90	.65	.65
Total price per lineal foot as per Tender and Contract	50.36	55.15	42.49	22.93	53.35	43.00	25.85	24.25	36.90	29.90	26.70	36.50	30.50	25.25	24.25	30.60	24.25	36.90	29.90	24.90

ACCEPTED TENDERS FOR SEWERS AND MANHOLES — ESTIMATE AND ACTUAL COSTS

Diameter of Sewer	Contract Price per Lineal Foot	Manholes per Lineal Foot of Depth		Length in Feet	Total Cost as Estimated from Tender Including Manholes	Actual Amount Paid to Contractors	Remarks
		Ordinary Manholes	Manholes with Drop Connections				
10'6"	$ 50.36	$ 19.77	$ 64.60	3208.10	$ 177890.23	$ 182196.71	
9'6"	55.15	23.50	89.25	1713.10	105329.71	104429.26	
8'0"	42.49	23.50	84.55	2995.10	134410.00	134192.78	
8'0"	53.35	25.00	95.00	3996.90	231659.50	228797.60	
6'6"	43.00	25.00	[illegible]	2199.10	109343.00	*107495.30	
6'0"	36.90	47.60	142.25	1194.70	51108.00	51347.79	
6'0"	36.50	60.00	120.00	1761.70	60831.00	70270.19	Manhole forms junction of 4'6", 5'0" and 6'0" diam. sewers
6'0"	36.90	53.50	129.00	4532.40	191974.00	190783.86	
5'0"	29.90	47.60	131.00	4633.10	147582.00	155688.78	
5'0"	30.50	60.00	120.00	1864.05	62675.00	60084.78	Manhole forms junction of 4'6", 5'0" and 6'0" diam. sewers
5'0"	30.60	60.00	125.00	3339.30	111375.00	107895.40	
5'0"	29.90	53.50	123.70	4639.70	153557.40	150044.75	
4'6"	22.93	15.00		1624.30	39028.00	50914.79	No manholes with drop connections on this line
4'6"	25.70	47.60	117.00	1608.30	48485.00	48224.86	
4'6"	25.26	60.00	120.00	4067.95	107887.50	125930.40	Manhole forms junction of 4'6", 4'0" and 6'0" diam. sewers
4'0"	25.65	25.00	95.00	1952.70	57148.50	55869.29	
4'0"	24.25	50.00	106.00	6251.50	177925.00	174464.89	
4'0"	24.25	50.00	111.25	3588.70	91485.00	102869.37	
4'0"	24.25	50.00	115.00	4090.50	106912.00	111452.31	
4'0"	24.90	53.50	138.25	2461.10	68518.00	68043.64	

ing that on the line of the sewer on the Edmonton Trail. The borings taken on the first contract, namely, 10-ft. 6-in. sewer all showed good ground, all the pockets of bad ground being between the borings.

In the tables to which reference has been made there is given a subdivision of the costs making up the unit price bids. The prices as given in this table are those given in the tender submitted by the successful tendered. The purpose of this is to facilitate making up the monthly estimates for payment of the contractor. How nearly these represent the true costs of the various detail operations can only be estimated, as actual detail costs could only be given by the contractors who carried out the work. The average prices of labor and material in Edmonton during the period when these contracts were carried out were:—

Labor.—Unskilled labor, 30c. an hour; miners, 50c. an hour; miners' helpers, 40c. an hour; hoist men, 35c. an hour; bricklayers, 75c. an hour; teams, 70c. an hour.

Material.—Cement, $3.03 to $3.28 per bbl. f.o.b. cars Edmonton; gravel for blocks, $2.25 to $3.00 per cu. yd. delivered on job; gravel for backing, $2.00 to $2.25 (contained sand) per cu. yd. delivered on job; sand, $1.75 to $2.25 per cu. yd. delivered on job; steel, 4c. to 5c. per lb.; lumber, $20.00 per M. delivered.

Construction of Sewer.—The concrete blocks used consist of one part of Portland cement, two parts of sand, and three parts of gravel or broken stone passing a one-inch screen. On contract No. 1 (Messrs. Manders & Gregory), the blocks were first made at a gravel pit about seven miles east of the city, and transported in cars on the steam railway. Only a small number of blocks was made here, as the gravel supply failed to meet expectations. The plant was moved to a location on the Saskatchewan River, not far from the outlet of the sewer under construction. A large shed heated by steam pipes was built so that operations could be carried on during the winter. Most of the gravel used was washed river gravel supplied to the contractor by the Huff Gravel Company. When contract No. 2 was awarded to the same company, another block-making plant was started on the property of the Government Penitentiary Reserve. This plant was more advantageously situated as regards obtaining material (other than river gravel), and by far the greater part of the blocks made by Manders & Gregory themselves were made at this plant, which also supplied blocks for a later contract awarded to McGarry & Company.

The largest block-making plant was located at Columbia and 13th Street, immediately north of the Canadian Northern Railway yards, a spur being laid to the plant to supply materials. Here were manufactured all the blocks used in the sewers constructed by Ulen & Company. The manufacture was carried on by the Midland Construction Company, who held a sub-contract from Ulen & Company. A light railway connected the plant with all points where blocks were used.

The wooden forms used by Manders & Gregory were metal lined so as to give a smooth finish to the inner surface of the block, a roughness on the other faces being more desirable than otherwise. The forms were made in gangs, with the metal lined face at the bottom, and as soon as the blocks had set sufficiently, the sides and divisions were removed, leaving the blocks standing on the metal face. After about 48 hours the blocks were carefully removed from the forms so as to prevent breaking off the sharp corners.

Plant.—The plant used consisted of concrete mixers (used chiefly in block making), electric hoists, and one motor-driven conveyance of the Ulen Company. Forty-one electric hoists were used in the shafts, eleven by Manders & Gregory, six by McGarry & Company, and twenty-four by Ulen & Company. They varied in size from 5 to 11 h.p.

Excavation.—Shafts from which tunnelling proceeded were located at intervals of 200 feet to 1,150 feet. Except in a few cases on Ulen & Company's work where auxiliary shafts were sunk to expedite operations, the shafts were built up to form the manholes after completion of the sewer. The shafts were generally sunk as a rectangular excavation, and timbered in the usual manner, tunnel excavation proceeding in both directions from the level of the invert. The material encountered was mainly a stiff gray clay with occasional pockets of sand. Except where sand occurred, practically no timbering was necessary, the ground holding perfectly. The cross sections were trimmed true to shape, and no cavities existed between the sewer and the earth walls. This is also true of the sections in bad ground, but in many cases the nature of the material required some of the timber to be left in.

On a portion of Ulen & Company's work, the shafts were sunk as circular excavations, timbered by means of sets of vertical lagging about four feet long, held in place by steel bands. These bands were in two parts, the ends being bent over to form a flange. They were made heavy enough to resist distortion from the pressure of the walls of the shaft. In sinking the shaft, the excavation was made for about four feet, care being taken to have it trimmed truly circular and the right size. The first set of lagging and bands were then put in place, the bands being wedged out at their junctions to tighten them up against the lagging. Another four feet was then excavated, and the lagging put in directly below it and the bands then inserted. By placing one of the bands in position before putting in all the lagging, this latter operation was made easier. This type of shaft worked very well where the ground was good, and was somewhat cheaper than the rectangular.

Small charges of dynamite (½ to 1 stick) were used to loosen up the clay, after which the excavators took it out, using a mattock instead of a pick. These tools were also used in trimming the cross-section to shape. The material as it existed in the face possessed a rubbery elastic property, and a pick simply sank into it without loosening it. However, the material when excavated and exposed to the air changed its character, drying and breaking up similarly to the disintegration of lignite coal when exposed to air. The material was not a shale but a boulder clay having a number of stones scattered through it ranging in size from half an inch to small boulders.

The excavated material was transported on a small car to the foot of the shaft, where it was hoisted to an elevated track and dumped into wagons. The completed sewer followed the excavation closely, except where it was thought necessary to hold back to prevent injury from blasting. The shock was never serious, however, owing to the small charge used, and the completed work was never more than 15 feet from the face of the excavation.

The tunnel was electrically lighted, and the absence of forms facilitated the laying of a small track for the cars carrying the excavated material, and the blocks, etc., used in the sewer.

Most of the sand pockets encountered were comparatively short, but one fairly long stretch, not detected in the preliminary borings made before the contracts were let, was met on the Fort Trail. In this case a tongue of wet sand stretched across the sewer, and it chanced that a test hole had been bored on each side of the tongue in good ground. The progress in sinking a shaft at the corner of Fort Trail and Cleave Avenue was so slow, that knowing the variable occurrence of bad places, borings were made in the vicinity with the object of changing the line to avoid the bad ground. This was found to be possible without affecting the utility of the sewer, and with practically no additional cost. The contractor was agreeable to the change, and abandoned the work already done on the shaft. A safer and better sewer was constructed, and the contractor on his part escaped a rather difficult piece of work.

Block Laying.—After the excavation in a length was completed the subdrain was laid. Then the concrete was laid in the bottom, to the level of the bottom of the blocks. The lower half of the hooping band was then placed on the concrete, and the invert block on top of the band. The remaining blocks up to the springing line were added, the backing concrete being placed as the block laying proceeded until the lower half of the ring was complete. A short wooden form extending partly into the finished sewer was then used to complete the upper part of the ring. The reinforcing crown bar, previously bent to the proper shape, was first placed in position against the face of the previous ring, so as to rest on the projection of these blocks. Block laying was then continued, care being taken to fill the joints between the blocks thoroughly, so that the reinforcing bar and the jointing irons would be surrounded by and bedded in the mortar. After the last block was placed at the top, the upper half of the hooping band was put on, the halves being connected by coupling shoes, and drawn up tight by wrenches. This point was watched carefully by the inspectors. After tightening the band the concrete backing was placed so as to fill the space between the blocks and the earth. The lower half of the ring having been extended meanwhile, the form was moved ahead and the process repeated.

In completing a junction of the sewer between any two shafts, the operation is very simple. After the excavation work on any two faces has been completed, the work of constructing the sewer on each side of the junction is carried on in the usual manner. A measurement is made of the gap between the two sections of sewer, before these approach too close, in order to ascertain how many tiers of blocks will he required to fill the gap. In this way it is often possible, by slightly increasing the width of the joints, to have the final tier of blocks just nicely close the final gap. At other times it is seen by the measurements that the final gap cannot be adjusted to a block in width except by too great a change in the width of the joint. In such cases, the final gap is closed by cutting the blocks to the required width. The lower portion of the sewer is thus completed with blocks with out difficulty. The final gap in the upper half is made with mass concrete, working from each side up towards the crown, lagging being used to hold the concrete in place; these being added from time to time as the work progresses towards the crown. The last small portion at the crown is lifted or shoved into place. After the concrete has set sufficiently, the forms are removed and the work smoothed off, leaving the junction with the appearance of a very wide joint. These junctions were so well made that the ordinary observer walking through the sewer would not notice them, unless he were looking specially for them, or had his attention directed towards them.

Rate of Progress.—The rate of progress was 30 to 36 feet of completed sewer in each face per week. Progress varied somewhat in the different sizes of sewers, but not so greatly as might be expected, as the extra work entailed in the larger sizes was in a measure made up by the greater number of men in the shafts. In the 4-ft. 6-in. and 5-ft. sewers, two men worked at the face, one as car pusher, and two or three men on top, exclusive of hoistmen and foreman. The former served the two faces worked from his shaft, and the latter looked after several faces. In the 6-ft., 6-ft. 6-in. and 8-ft. sewers three men worked at the face, and there were two car pushers.

Work was carried on in two 10-hour shifts. At first the block laying was done by special men, but during most of the work, excavation and block laying were done by the same men. The results were equally good, but the latter method gave less trouble, as the continuous nature of the employment attracted plenty of men to select from, and provided a good class of labor in the shifts. The men doing the block laying were taught by the inspectors to pay special care to the particular points necessary to ensure satisfactory results.

Manholes and Drop Connections.—As soon as the sewer on each side of a shaft was completed, the manholes and drop connections were constructed. The contractors preferred, and were allowed to use, the block form of construction in the lower half of the sewer passing through the manhole. The shaft timbering was drawn as the work of building the chambers leading to the surface progressed. Both outside and inside forms were required in building the manhole barrel and drop connections. Part of the former was removed as the work progressed, and before the back filling was placed. The inside forms were removed from below.

Inspection.—The inspection of the materials used in the sewer was carried out at the laboratory of the University of Alberta. All cement and steel used was subjected to the usual tests, and compressive tests were made on 4-in. cubes of concrete as used in the blocks. The cubes were made by the inspector at the block-making plant from a portion of the actual mix, and thus fairly represented the concrete in the sewer. The sand and gravel used through the work were inspected by the resident inspectors, and the sand was also treated in the laboratory of the University.

Inspection of Workmanship.—A resident inspector was kept at each block-making plant during operations. He was responsible for inspection of all material used (other than cement), for the use of the proper proportions in the concrete, for the method of mixture, placing in forms, handling of finished blocks, dating of blocks, and disposal of rejected blocks.

The inspection of the workmanship in the sewer itself was carried on by a number of inspectors sufficiently large to allow one inspector to about four or five faces. Special attention was directed to the block-laying process, the mixing and placing of concerte backing, and the placing of all steel reinforcement.

Written daily reports were received by the Resident Engineer who forwarded them to the Central Office for future reference.

Engineering.—The engineering organization of the work is represented in the diagram below:—

City Engineer,
Assistant Engineer in charge of Sewerage and Drainage
Resident Engineer in charge of Tunnel Sewer,
Instrument Men. Inspectors.

Although large numbers of inspectors were employed when all contracts were in operation, yet the number of engineers employed was comparatively few, being never more than three.

The general method employed is setting out line was to suspend, by means of piano wire, two 20-lb. plumb bobs down the shaft, these being immersed in a pail of oil. The two wires were brought into line at the surface by means of a transit, which was then taken below and the line extended into the tunnels. The level was transferred down the shaft by means of a steel tape, the point so obtained being used as a bench mark in giving grade. As the two faces approached within 10 to 15 feet, an opening was driven through to allow the meeting of grades and alignment to be checked. No adjustments were necessary, as all faces met both in alignment and grade with almost perfect accuracy.

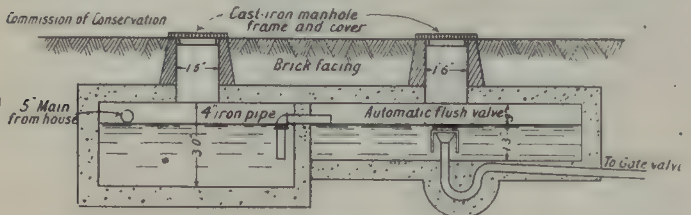
Progress charts were made and brought up-to-date every two weeks, the progress of each two weeks being shown in colour, so as to make comparisons easy. The character of the ground passed through was also shown, chiefly as a matter of record, although it served also to explain many variations in the rate of progress.

The aqueduct conducting the waters of the Owens River, at Los Angeles, is said to be the largest in the world. It is designed to deliver a minimum of 258,000,000 gallons of water daily into the San Fernando reservoir, 25 miles northwest of the city. No pumping plant is required, as the source of supply is several hundred feet above the city. The water will furnish a great amount of power—70,000 horse-power is anticipated for electric lighting and other purposes. The total cost of the waterworks will be $25,000,000, and the installation of the power plant will be approximately $5,000,000 more.

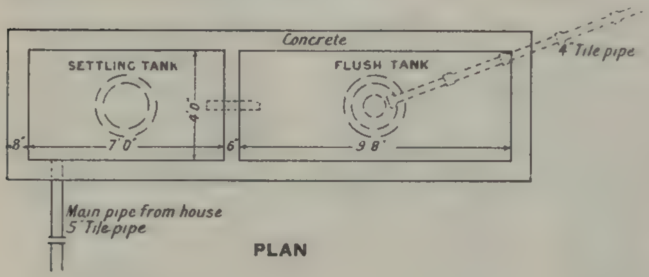
Septic Tanks for Sewage Treatment in Isolated Homes

IN small towns and on the farm, the common system of sewage disposal is that of privy pits or cesspools. This method fouls the ground and air, holds the wastes in a state of putrefaction which gives off foul gases, and the liquid leachings are liable to injure the quality of wells and springs.

During recent years, many investigations of sanitary methods for the disposal of sewage of isolated houses have been made. The principle upon which the successful treatment of sewage depends is briefly as follows: When the air contained in the soil is brought in contact with dead organic matter in a finely divided state, complete transformation takes place by the natural processes of oxidation and nitrification. As air is necessary for this purpose, it is essential that the waste be deposited on or near the surface. If the ground is saturated for a long time, purification of the liquid ceases; consequently the principle of intermittent operation of the disposal plant is necessary. The process of applying this principle involves the collection of the material away from the house, the settling out of as much of the solids as possible aided by anaerobic action, and the intermittent application of the effluent to the natural soil by surface or sub-surface irrigation, or to a specially prepared soil, as a filter bed.



LONGITUDINAL SECTION



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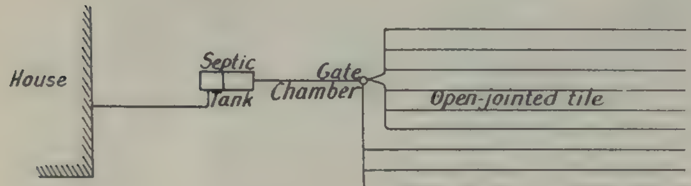


Subsurface irrigation for level ground

Design for concrete septic tank.

A water supply is necessary for the collection of the material and this can be obtained and piped into the house by means of a hydraulic ram operated by a small stream of potable water or by means of a deep well fitted with windmill or pump force.

It will usually be necessary to dispose of the effluent from the settling chamber or septic tank by means of sub-surface drainage.

Illustration No. 1 shows a good type of tank for handling the sewage for a family of five and having a capacity of 350 gallons per day.

All sewage coming from the house passes into the settling chamber, where the solid matter to a greater or less extent is deposited. Owing to the character of the sewage, the decomposition of the solids is so active as to prevent any serious accumulation in the bottom of the settling chamber. It is necessary to inspect the chamber from time to time, and, if undissolved solids accumulate, to have them removed, probably about once a year. This accumulation should then be carried to the field and spaded into the soil at once.

The cost of a tank built of concrete, such as the one shown, will depend on cost of cement, wood for forms, etc., but the cost of all the material including siphon and cast-iron manhole covers will be, approximately, $60.00.

To secure subsurface disposal, 3-inch agricultural drain-tile are laid with open joints, the bottom of the tile coming within 12 inches of the surface of the ground. These drains should be laid with a slight fall, say two inches per 100 feet. The ground should be naturally or artificially so well drained that water will descend through it readily.

In a country with as severe a climate as parts of Canada, where frost will affect the ground to a depth of four or five feet, it would be necessary to cover the surface of the ground above the tile with straw, leaves, or other kinds of mulch in order to prevent the frost affecting it. The superficial area of the disposal plant outlined above would not be greater than 40 feet by 100 feet.

Illustration No. 2 shows a sub-surface system adapted to level ground. The tile lines are divided into three series leading from the gate chamber, so that the ground utilized by two lines is given a complete rest while the other is in use. The length of tile required will depend upon the porosity of the soil. For a porous soil, one foot of tile for each gallon of sewage should dispose of the liquid; for clay there should be at least three feet of tile per gallon.

A recently patented fire escape that can be moved from window to window of a burning building consists of an extension ladder suspended from trolley wheels, which run on a suitable track permanently attached to the building just below the roof cornice. A person standing on the ladder or on the ground can move the fire escape to any point where it is needed, and in the case of flames bursting out of a window the ladder can be pushed aside so as to enable those on it to descend to safety.

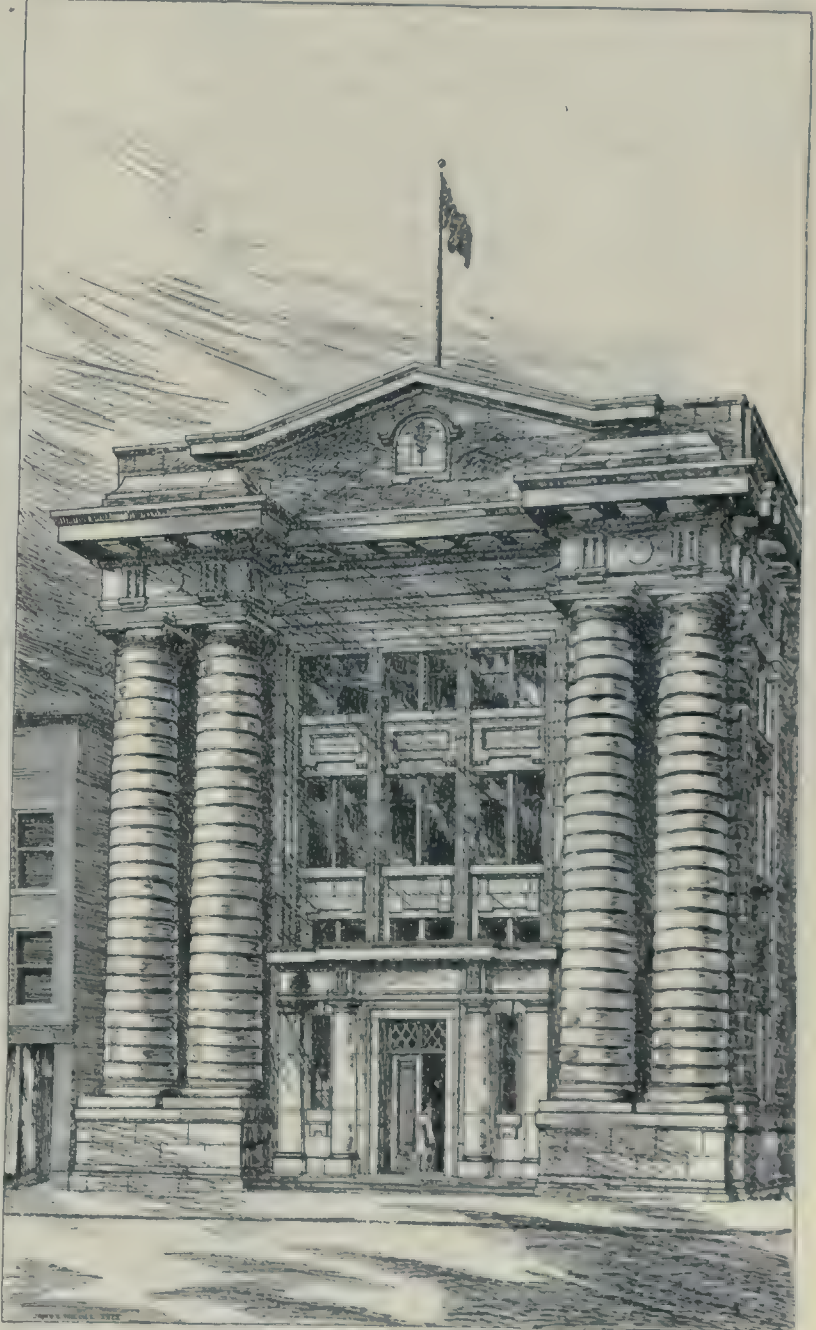
An important scheme for enabling the engineering industry to take advantage of the present situation has been prepared by a sub-committee of the Engineers' Club, of Manchester, Eng. Briefly it recommends the formation of an association of engineering manufacturers with the denfiite object of advancing the interests of the industry in every part of the world. The committee advocates voluntary organization and co-operation in preference to large combines or trusts such as exist in Germany and the United States. They state that "the capital invested in the British engineering industry is estimated at over £300,000,000. If firms representing this large sum would co-operate and equip themselves for a determined and soundly organized effort, there should be no question of their ability to capture the large trade now going a-begging."

New Bank Building for Main St., Vancouver

THE accompanying illustration shows the design for the substantial branch building which the Canadian Bank of Commerce is erecting at the corner of Main and Pender Streets, Vancouver, at a cost of $125,000. The building will be three storeys high, and it will have a frontage of fifty-six feet on Main Street, and a depth of ninety feet on Pender Street.

With the exception of one store to the rear, the entire ground floor is given over to the banking room. The interior will be divided by two ranges of Doric columns, and the side aisles and ceiling will be supported by deep moulded beams. The counters and woodwork will be of quarter-cut oak. The main part of the flooring will be done in marble. The upper floors are laid out for renting as offices. The building is to be fireproof throughout, the structural system consisting of reinforced concrete and terra cotta tile. The lower portions of the exterior of the building is designed in B. C. granite, and the upper portion in unglazed terra cotta. Of the interior installation mention may be made of the latest improved type of Otis-Fensom electric passenger elevator. The speed of this elevator is two hundred and fifty feet a minute. It is equipped with the latest safety devices.

The building was designed by Mr. V. D. Horsburgh, F.R.I.B.A., of Toronto, represented in Vancouver by Mr. W. F. Gardiner. The contractors are Messrs. Baynes & Horie. The design for the reinforced concrete work is by Mr. P. Brown, A. M. Inst. C. E.



Proposed new Vancouver branch building for the Canadian Bank of Commer

Town Planning in Antwerp

TO our London contemporary, The Builder, we are indebted for the report of an interesting lecture on "Town Planning in Antwerp, Past and Future," given at University College by M. Alfred Portielje, Hon. Secretary Royal Society of Architects, Antwerp. As far as the past is concerned, M. Portielje confined himself mainly again to an historical survey of the growth of the town. He pointed out that Antwerp is, above all, a commercial city, with one of the finest harbours in Northern Europe. It reached the zenith of prosperity in the sixteenth century, whilst the seventeenth century saw the town at its artistic height. A castle built about A.D. 640 close to the banks of the River Scheldt formed the central point around which the earliest settlement grew. As the latter expanded the houses were largely built on ground won from the river, and for centuries the constructors were hampered by the rivers and canals and by the existing fortifications. In fact, any enlargement on a big scale was a serious matter, as it meant disturbing and reconstructing the walls and forts. These have, of course, always played an exceedingly important part in the history of the town, and the lecturer mentioned that Albrecht Durer was consulted with reference to them in 1510, whilst an Italian military architect, Donato, remodelled them in 1540. The cathedral church of Notre Dame was commenced in 1322, and its beauty is too well known to require emphasizing. The tower was completed as far as the first stage in 1434, the upper portion, the spire, being of a later and more flamboyant period. M. Portielje illustrated by slides the lines the fortifications followed at various times, and the way Napoleon intended to deal with this problem. During the nineteenth century many modern improvements were undertaken, mostly from the designs of the engineer Von Weber, including docks and dry docks. In the second half of the century a fine avenue was constructed along the line taken up formerly by the city walls, and the park and quays were laid out. The lecturer showed some slides of public buildings in the Renaissance period, amongst which were the Porte Imperial, the Flemish theatre, and the Athenaeum. Turning to the future, M. Portielje gave particulars of a Town Planning Competition held in 1910, and explained the slides he was able to show.

Canadian Municipal Engineers

E. Drinkwater, Town Engineer, St. Lambert, Que.

THE Town Engineer of St. Lambert, Que., Mr. E. Drinkwater, has had the advantage of more practical experience in constructional work than the average professional man. He has been identified with many important undertakings, and his record is an interesting one. Born at Manchester, England, in 1869, he was educated in the Collegiate and Technical Schools of that city, and made his first connection with the constructional business at the age of eighteen, when he joined his father, who was carrying on a general contracting business in drainage works, street improvements, and the erection of industrial plants and residences. Coming to Canada in 1902, he was employed for several years on street railway work, and power house construction and operation. For three years he was General Superintendent and Chief Inspector of Works at Westmount, Que., having full charge of drainage work, paving, municipal plant and maintenance.

Mr. E. Drinkwater, Town Engineer of St. Lambert, Que.

Mr. Drinkwater was appointed Town Engineer of St. Lambert in 1912. He has charge of roads, drainage, buildings, waterworks, and electric light—so that there is ample scope for the application of his wide experience. He is just completing a general improvement scheme involving the expenditure of $500,000. The project involves converting the drainage system from a combined to a separate sanitary and storm system. Also it includes five miles of sanitary and seven and a half miles of storm sewers (all laid to provide for the ultimate requirements of the district), five and one-half miles of concrete sidewalk, and five miles of street pavement in cement and bituminous concrete.

A notable achievement of Mr. Drinkwater's is the design and construction of a garbage incinerator. This plant is designed with natural draught and single chamber. It destroys mixed garbage at the rate of one ton an hour, regardless of the moisture contained, and without causing a nuisance. Its total cost was less than $300, and it is capable of dealing with more than twice the present requirements of St. Lambert.

Mr. Drinkwater has just completed plans for a sewage disposal plant which will have an ultimate capacity of ten million gallons a day.

In these stirring times it is of interest to note that Mr. Drinkwater is a cavalry officer in the Canadian Militia.

Suggestions for Laying Terra Cotta

TERRA cotta should always be set in either natural cement or Portland cement, mixed with sand, and in about the same way as stone is set, says a writer in The Building Age. As soon as set, the outside of the joints should be raked out to a depth of three-quarters of an inch to allow for pointing and to prevent chipping. The terra cotta should be built up in advance of the backing, one course at a time, and all voids, except those projecting beyond the face of the wall, should be filled with grout or mortar, into which bricks should be forced to make the work as solid as possible. All blocks not solidly built into the walls should be anchored with galvanized iron clamps, the same as for stonework. All projecting members over 6 inches in height should be anchored in this way. After the walls are up, the joints should be pointed with Portland cement colored with a mineral pigment to correspond with the color of the terra cotta. The pointing is done in the same way as in stonework, except that the horizontal joints in all sills and washes of belt courses and cornices, unless covered with a roll, should be raked out about two inches deep, calked with oakum for about 1 in., and then filled with an elastic cement.

The weight of terra cotta in solid blocks averages 122 lb. per cubic foot. When made in hollow blocks 1½ in. thick, the weight varies from 65 to 85 lb. per cubic foot, the smaller pieces weighing the most. For pieces 12 by 18 in. or larger on the face, 70 lb. per cubic foot should be a fair average. The crushing strength of terra cotta blocks in 2 in. tubes varies from 5,000 to 7,000 lb. per square inch. Hollow blocks of terra cotta, one foot high, unfilled, have sustained 186 tons per square foot. From these and other tests I would place the safe working strength of terra cotta blocks in the wall at 5 tons per square foot when unfilled, and at 10 tons per square foot when filled solid with brickwork or concrete. If it is desired to test the strength of special pieces, two or three small pieces should be broken from the blocks and ground to 1 in. cubes, and then tested in a machine. Should the average result fall much below 6,000 lb., the material should be rejected.

Canada is playing a part of growing importance in supplying the allied armies with the munitions of war. The latest development in this field is an order worth $83,000,000 from the Imperial Russian Government. This huge contract, which calls for five million shells, has been obtained in Petrograd by Mr. W. W. Butler, Senior Vice-President of The Canadian Car & Foundry Company. The extent of the order is such as to necessitate submitting various parts to other firms for manufacture, especially as three of The Canadian Car & Foundry Company's plants are already turning out shells to the order of Great Britain. Mr. Butler anticipates development of the Russian-Canadian trade on permanent lines.

To make a permanent cement used for stopping leaks in steam pipes where caulking or plugging is impossible, mix black oxide of manganese and raw linseed oil, using enough oil with the manganese to bring it to a thick paste; apply to the pipe or joint at leak. It is best to remove pressure from the pipe and keep it sufficiently warm to absorb the oil from the manganese. In twenty-four hours the cement will be as hard as the iron pipe.

The Development of the Sand-Lime Brick Industry in Europe

By E. R. Sutcliffe

THE sand lime brick industry in Europe has progressed satisfactorily in recent years. In Germany and France the progress has been most marked. In France there are about six times the number of works that there were in 1906.

My connection with the industry dates back to 1894, when I made my first design for a sand lime brick rotary table press, and ever since I have kept in close touch with its progress. In those days the industry was confined to Germany, where for years it was retarded by different inventors claiming to hold process monopolies under patents. Between the years 1896 and 1900 the greater portion of the machinery and presses for the German works was imported from England, so that, while the industry was German in its inception, much of the pioneer work was originated in Great Britain.

The development of the industry in Europe up to the year 1906 was considerable. Then it was computed that two hundred and sixty-eight works were in operation or being erected, with a production of about a billion bricks per annum. Owing to the War, I am not able to get accurate information as to the present position, but to the end of 1913 I compute the work in the different European countries to be as follows:—

Germany	311	works,	annual	production	about	1,555,000,000
France	43	"	"	"	"	150,000,000
Holland	15	"	"	"	"	75,000,000
Great Britain and Ireland	9	"	"	"	"	15,000,000
Sweden	9	"	"	"	"	24,000,000
Denmark	7	"	"	"	"	18,000,000
Switzerland	4	"	"	"	"	8,000,000
Austria	4	"	"	"	"	8,000,000
Spain	4	"	"	"	"	10,000,000
Norway	3	"	"	"	"	6,000,000
Belgium	3	"	"	"	"	6,000,000
Portugal	2	"	"	"	"	5,000,000
Russia	5	"	"	"	"	10,000,000
	419					1,890,000,000

In comparing these figures with the development of the industry in the United States or Canada, the dimensions of the bricks made in the various countries should be taken into account. The American or Canadian brick of 8¼ ins. x 4 ins. x 2 ins. has a content of 66 cubic inches, whereas the size of the German brick is 9¾ ins. x 4¾ ins. x 2½ ins., or a content of 115.75 cubic inches, and an Austrian brick measures 11½ ins. x 5½ ins. x 2½ ins., or 158 cubic inches. The English and French bricks also are larger than the American, so that we may say that the bricks in bulk would be equal to three thousand million American or Canadian bricks.

In Germany the majority of sand lime bricks are common bricks, and I estimate the average selling price of the bricks at the works at 21 marks, or, say, $5.10 per thousand, and the "All In" cost price of manufacture at 16 marks, or say $3.90 per thousand, leaving a profit of $1.20 per thousand. Hence the total value of the German trade in these bricks reaches a round figure of about eight million dollars, with a profit of one million eight hundred thousand dollars. From my knowledge of the substantial way in which their plants usually are laid out, I would put the capital value of the industry at 50,000,000 marks, or round about $12,500,000. I have made out figures in this way with a view to more clearly showing the importance of the industry on this side.

The methods employed in Germany for their manufacture are various, but the three following are the principal systems adopted. Given suitable local conditions, I would put them all on an equality as regards efficiency and quality of output.

Charge Mixer Process

This process consists in mixing the materials in a batch of five hundred to as many as four thousand bricks at one mixing. The fresh quicklime is ground down to a mesh of about 30 x 30 per lineal inch, then fed along with an equal quantity of sand (or in some cases even double or treble the quantity of sand) into the mixer, at the same time adding the necessary quantity of water for the hydration of the lime. This preliminary charge is then mixed for a period ranging from twenty to thirty minutes, during which time the lime becomes slaked. The remaining bulk of the sand to bring the proportions of the mixture to six per cent., seven per cent. or eight per cent. of lime, as the case may be, is then added, and a further mixing for a period of about ten minutes completes the operation, after which the material is ready for pressing.

Sometimes these mixers are steam heated, with steam jackets; in other cases a certain amount of steam is blown into the mixer during the mixing operation, but as naturally owing to the slaking of the lime the mixer becomes very hot, there is no necessity for steam heating, or even for blowing steam into it. In some cases the mixer is tightly sealed up so that a certain amount of pressure will rise in the mixer during the operation caused by the steam generated in slaking the lime. In other cases no attempt at sealing up the drum is attempted. I have seen cases where steam jacketed mixers have been used, and where in time the interior lining of the drum has been worn through so that the mixer could not stand the pressure, and then the mixing has gone on without the use of pressure or steam, simply the heat generated in slaking the lime being sufficient to hasten reaction. Some of these mixers will range in dimensions capable of mixing a charge of twelve or thirteen cubic yards.

As a rule, the prepared material on being discharged from the mixer is allowed to fall into large storage hoppers with automatic feeders which regulate the discharge to the various presses. Sometimes edge runner mixing mills are used for the final preparation of the material after passing through the mixer.

The measuring of the sand and lime in the required quantities is occasionally effected by weight, but more generally by using measuring hoppers. In other cases, where large mixers are used, so many wagon loads of sand will constitute the respective charges along with a hopper of lime. As the mixing is invariably effected on the upper floor of the building, lifts are frequently used for taking the sand to the top storey.

The ordinary method of grinding the lime is to use an ordinary ball mill.

Hydrated Lime Process

In this process the lime is hydrated before mixing with the sand, and perhaps the most useful method for hydrating the lime is in large slaking drums or trommels, which consist of drums about four to five feet in diameter and twelve to fifteen feet in length, revolving on end trunnions with suitable charging ports in the drum. Into this the lime is fed along with the required quantity of water for hydrating it; the drum is then set revolving slowly for a period of time required for effecting the hydration, which will range from half an hour to one hour, after which the lime is discharged into suitable receiving hoppers to be screened later, or in some cases passed through a disintegrator.

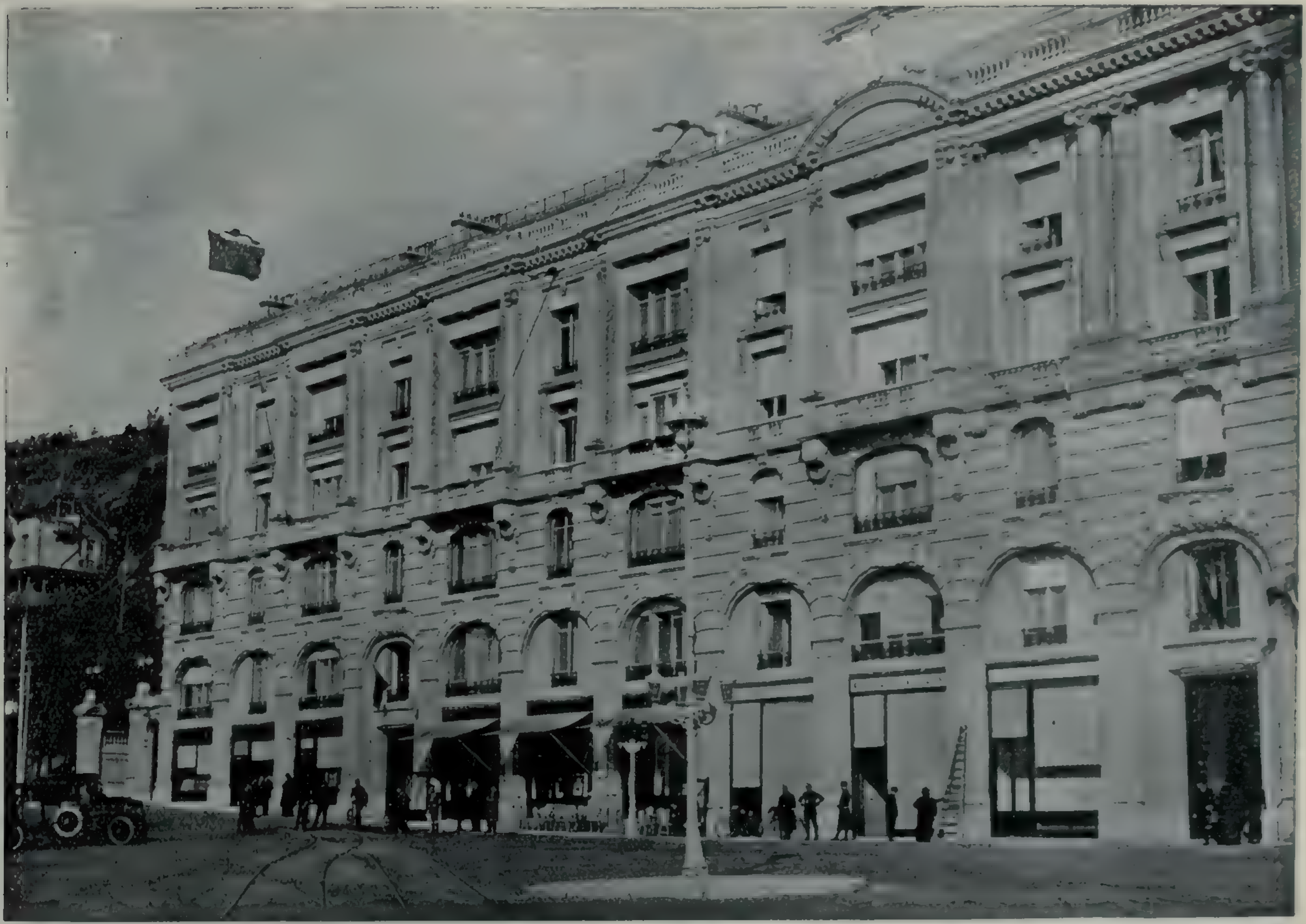
The final mixing of the material with the sand is then effected through a series of suitable measuring apparatus for measuring the required proportions of sand and lime, the final mixing invariably being done in edge runner mixing mills.

It is found generally that it is advisable to allow the lime to stand for one or two days before being drawn upon for mixing up with the sand, as this allows the lime to be more certainly slaked. In some cases, with these slaking drums, a portion of the sand is added with the rough lime in the drums.

While not now generally adopted, a system in use which gives fairly good results, and which is simple, is to simply charge up the lime in side or end tip wagons, and to pour into these wagons the measured quantity of water which experience has shown is required for the hydration of the lime, and then to run the wagons during the day time into the hardening chambers, where they can be kept warm. This lime is afterwards screened and mixed up with the sand. This system comes really from one of the first methods used, which was to have small wagons fitting beneath the lime sand brick cars in which the lime was steamed and slaked at the same time as the bricks were hardened, and such methods are still in use in a number of cases.

In this system the quicklime is ground in its fresh state to a mesh of about 30 x 30 per lineal inch, after

A sand-lime brick building at St. Addresse, France—the Villa Hollandaise, which the French have placed at the disposal of the Belgian Government, and which is now the official home of Belgium's Foreign Minister.



Another sand lime brick building at St. Addresse, now being used by the Belgian Ministers of State as temporary offices. The building consists of a series of flats, with shops underneath.

which it is measured in the required proportions with the sand, and then mixed in paddle mixers, where the necessary quantity of water is added for hydrating the lime. The material is then allowed to fall into large silos or bins, where it is permitted to rest for a period ranging from five hours up to twenty-four hours, after which the material is drawn upon for the final mixing with additional water, if necessary, and passed on to the presses.

The silos or bins into which this material is put are usually arranged in such a way that while one bin is being charged the other can be drawn upon for use in the plant. The most general type of silos used are those consisting of cylindrical drums made of steel, with an automatic discharge apparatus at the base of the bin, the paddle mixer for mixing the materials being placed on an upper staging erected over the top of these silos, so that the mixed material can gravitate into one or the other.

Ordinary paddle mixers are used for the final mixing of the material prior to its coming to the press, and in some cases edge runner mixing mills are used for this final mixing. In a representative plant the silos will be fifteen feet in diameter and about thirty-five feet in height.

The largest sand lime brick works in the world—viz., that of R. Gutman, near Berlin, Germany—operates on the silo system as above described. This plant when in full operation has an output of five hundred thousand bricks a day. It is a wonderfully well-organized works.

Some of the German brick works are fitted up with small electric locomotives for hauling the wagons of bricks into and out of the hardening chambers and to the stacking ground. A feature which I have seen in use in the larger works is to collect a whole train-load of cars sufficient to fill a chamber on to one transfer car, which is then propelled in front of the hardening chambers and the whole train-load run in en bloc. Such a method, where plants are run night and day and the hardening chambers are kept in constant operation, results in economy and permits of the chambers being used to the fullest extent.

The great strides made in this industry in Germany are due largely to the early recognition that the ordinary machinery as used for making clay bricks was unsuitable for making lime sand brick, and the consequent provision of strong massive machinery suitable for the heavy work demanded of it. Then, also, it was recognized early that the industry would be stunted if the manufacturer aimed at supplying the facing brick trade only. The prejudice against the bricks, which was strong at first, was overcome, with the result that they are accepted quite as freely as burnt bricks.

In France much artistic taste has been shown in using these bricks. The color seems to please the French taste, and the refined effects they obtain with them are most pleasing. They are thus largely used for facing purposes, and their selling price is much higher than in Germany, but, on the other hand, their manufacturing costs are greater. The two photographs show two lime sand brick buildings at St. Addresse, near Havre in France, which, besides showing the refined French taste in the use of their bricks, possess interest at the moment as being placed by the French Government at the disposal of the Belgian Government. The building in Place Frederic Sauvage is used by the Belgian Ministers of State as temporary offices. The building is in a series of flats with shops underneath. The Villa Hollandaise is being used as the official home of the Belgian Foreign Minister.

The method of manufacture in France is chiefly on the slaked lime process. The French lime is obtained principally from soft, but very pure limestone, and slakes readily to an extremely fine powder. The hydrated lime industry has developed into an important industry, and consequently suitable hydrated lime is readily obtainable, and many lime sand plants obtain their lime ready hydrated from the lime works. In most works edge runner mixing mills are used for the preparation of the materials. The tendency has been to install light machinery, but it is gradually being realized by makers that more robust machinery is required. In France the lime sand brick has come to stay, and there is no fear but that the industry will develop rapidly. I look for great developments as soon as the present European War is ended.

In Great Britain the progress of the industry is slow, in part due to the continued depression of the building trades, caused in a great measure by new Acts of legislation.

There is a scarcity of housing accommodation, but the returns on the capital invested in cottages and house property are too low to tempt private enterprise. However, this is a state of affairs which promises to right itself in the near future. A reason for the slow progress is also to be traced to the fact that we have in all parts of the country excellent shales and clays for brickmaking. In the north the quality of the clay and shale bricks is particularly good, being made almost exclusively on the stiff plastic and plastic process, and to compare with such bricks in quality a high grade lime sand brick is required, necessitating the use of tube mills or other grinders.

Then, again, common shale and clay bricks of about double the cubic dimensions of an American brick are sold at $5 to $6 a thousand, so that the opening for lime sand bricks is limited to particular areas and for use as facing bricks. At the same time, high-class quality lime sand bricks could be made under English conditions, to sell at even this low price, with fair profits; but for the development of a new industry where some prejudice has to be overcome higher returns are looked for. We have suffered also from the unscrupulous company promoter, and a number of plants have in the past been installed which were doomed to failure from the commencement, their only object being to fill the purse of someone with a "process" for sale. In one case a plant was installed in which the sand had to be carted to the works at a cost of about $6 to $7 a thousand bricks. In another case a pinch of snuff or something equally beneficial was mixed in with the mixture, and in this case the layout of the machinery gave the impression that it had been erected where the lorryman thought it most convenient to unload his lorries.

In London and the south of England there are good openings for these bricks, sand being plentiful and clay bricks expensive. One plant in the London district—that of Mr. Jesse Clark, at Croydon—is doing extremely well.

In Holland the lime sand brick industry has taken a firm position. Considering the population, the industry has made as much progress there as it has in Germany, the type of plant and the methods adopted being similar to those employed in Germany.

Altogether, I consider that Europe has made satisfactory progress in this industry. Apart from lime sand bricks, on similar processes immense quantities of bricks are made from blast furnace slag, while in France clinker obtained from the burning of town refuse and from boiler ashes is utilized largely for brickmaking, the method employed for such manufacture being analagous to that used in lime sand brick manufacture.

British Method of Laying Brick

THERE is no craft in the building trade that looks so simple and easy to an outsider as bricklaying; yet if an amateur undertakes to lay a brick he will probably be surprised at the results as compared with his pre-conceived notions. Apart from gauged arches and ornamental carved brickwork where drawings are necessary, there is not any great amount of intricacy in setting out and executing an ordinary brick building, says F. Pelling, writing in the "Building World."

Spreading the Mortar

Before laying a brick it is necessary to have some knowledge of spreading the mortar. It should be spread evenly to the required thickness so that there shall be no violent knocking to set the brick into its proper position. The spreading of the mortar also finds out any extraneous lumps that would prevent the brick lying solid. The mortar should be sufficiently soft and plastic as to be easily spread with the trowel, and by its being plastic the waste of mortar will be more considerably reduced than would be the case if the mortar were short.

The bricklayer in working to the line will take up and spread about three trowelfuls of mortar in succession, as this is generally found to be sufficient at one time, or the mortar will stiffeu before the bricks are laid. In getting up piers and quoins only sufficient mortar is spread to take one brick, and the brick is laid before spreading more mortar. In every case the bed is left a little hollow in the centre and full at the edges, so that when the brick is tapped into position with the trowel it will lie firm. The mortar should be sufficiently soft to adhere, when drawn to the side of a brick, as a cross joint. It is necessary that the brick itself should be damp and free from dust to facilitate the adhesion of the mortar.

Qualifications as a Bricklayer

The writer on one occasion heard it said by an authority on brickwork that to see a bricklayer handling the trowel and spreading the motar was a good guide as to his abilities at bricklaying. The manipulation of the mortar is by no means an unimportant part of bricklaying, and in reference to the cross joints, unless the same amount of mortar is applied, the face bond will be affected through the perpends not being properly kept, thus spoiling the looks of the face work and weakening the bond.

The footing courses will be the start of bricklaying in a new building, and in reference to the footings it need only be said that the courses should be perfectly level and consist of all headers.

The next important item is getting up the corners, known technically as quoins. These require to be level and upright, for upon them depend the level and perpendicularity of the adjacent wall.

It should be stated that in starting to build a quoin there is a right and a wrong way to lay a brick. Some bricks have one frog, some have two frogs, and some have none at all. In the case of bricks with one frog, the frog should be laid uppermost, although sometimes, in order to keep a thin joint, they are laid frog downward. There is, of course, no alternative with a brick having two frogs; they are a special kind of brick, and do not form the general mass of brickwork. In the case of a brick without a frog, the brick should be laid the same way as moulded. This is generally distinguished by faint lines indicating where the clay was struck off in filling the mould; but in every case where the brick is hollow on the bed the hollow side must be laid downward.

Whatever bond is used in walls over 4½ ins. thick, a 2¼-in. lap should be given. This is obtained by cutting a closer to a wooden gauge of the requisite width. It is always used next to the starting header; then the bond is kept right on the face by making the cross joints the same width. The dimensions of the bricks must be uniform.

Tools Necessary for the Purpose

In building the quoin the bricklayer uses a plumb rule, straightedge, and spirit level to guide him to keep the brickwork true. After the quoin is raised about 2 ft., the plumbrule is not much used except as a check for correctness. The bricklayer uses a straightedge for every second-course corner brick laid, the bottom part of the straightedge resting firmly against the plumb bricks below. Two things should be avoided in getting up corners so that the intermediate brickwork when built shall bed solidly on the quoin. Of course, this does not refer to toothings left out for another wall, to be bonded into an existing wall at a later date.

In reference to the thickness of the bed joints it may be stated that the happy medium is the best—neither too thick nor too thin. This is best obtained by measuring the height of four bricks laid dry, and then allowing another inch for bed joints.

Having got the corners up about 3 ft. high, a gauge rod should be used to see that both quoins are rising correctly. It is much better and quicker and quite as accurate as levelling; of course, it is assumed that the corners have started from the same level course. Next the intermediate part is filled in by straining a line from corner to corner. If there is much length of line it will require tingling up to keep it from sagging. To tingle a line it is best to have a plumbing place at that point where the tingle is to be fixed so as to ensure the work being kept true. When the tingle brick is laid plumb with the correct thickness of joint, a short piece of string is looped round the line and the line drawn up to the edge of the brick. The tingle is fastened on the top of the brick by a small pat of mortar, on which is placed a piece of brick to keep the tingle firm. The line should be looked through each time it is raised as to its correctness, for the truer the line the more regular the work.

Laying Bricks to the Line

In laying the bricks to the line it is necessary to have an eye on the top and bottom front edge of the brick at the same time, so that, when laid, the brick will be flush with the one beneath it and also just clear of the line; then there will be no hatching or irregularities of the face bricks, which spoils the appearance of otherwise good work.

The ideal way of laying a face brick is to avoid any hard knocking of the brick to get it into its proper position after the mortar has been spread. In fact, the brick should be just squeezed or pressed into its bed by a slight rubbing motion, and the superfluous mortar caught on the trowel to form a cross joint for the next brick to be laid.

This buttering of the cross joint is sometimes objected to, but if, after the course is laid the remaining part of the joint is properly flushed up, the objection is more apparent than real; it is the omission of properly flushing up each course that causes bad work.

The bricklayer always examines a brick before laying it. The reason is to see which end and face is square one with the other; also, in face work the brick is examined as to its color and freedom from chips and flaws.

Importance of "Sectional" Bond

No mention will be made of the different kinds of bond in general use, as they are too well known, but perhaps it is as well to mention an important item which is often overlooked, namely, sectional bond. No matter which bond is used on the face of the work the same bond must be kept through the thickness of the wall. In other words, sectional bond is that the transverse joints run unbroken through the wall. When sectional bond is absent, strength will be wanting. It should have been mentioned that in laying bricks as an oversailing course, whether plain or moulded, the bricklayer strains the line to the bottom front edge of bricks and not to the top. The reason for this is that it is the underside or bottom edge of the brick course that catches the eye.

A passing reference as to bats. These accumulate by handling in transit from the brick manufacturers to the job, and the proportion of bats to a given quantity of bricks will depend on the quality of the bricks themselves. It is only fair to the builder who has to pay for them that they should be used on the job, and the bricklayer, in using them with discretion as they come to hand, will not harm the work to any appreciable extent. The evil of using bats is when they are allowed to accumulate to such an extent that they become a nuisance on the scaffolding and the bricklayer uses them in one part of the wall in order to get rid of them.

In conclusion, good bricklaying may be distinguished by the regularity of the face bond; by the absence of broken bond; the levelness of the bed joints; the perpendicularity of all angles, external or internal, producing sharp, well-defined lines; and the general smoothness of the face work.

Contractors in their eagerness to secure work for their outfits often neglect the necessary precaution of ascertaining the amount of funds available for the undertaking, says Engineering and Contracting. This spring a contractor took the contract for building some roads for a township. The contract price was $39,000. The township had authorized a bond issue of $30,000 and had an available surplus in the treasury of $5,000. The roads were constructed, but when it came time for a settlement, payment of the excess over the $35,000 was refused on the ground that the township board had no authority to enter into a contract for any greater sum than the amount of the bond issue. The contractor brought suit, but the Court sustained the contention that he had no cause for action. As a result the township gets $4,000 worth of work and the contractor gets the experience.

Bridge Practice in India

A three-truss single-track deck bridge is an interesting structure on the Northwestern Railway, of India, and is the result of reinforcing the original two-truss bridge to carry heavier loads. This is the Bishendore Bridge on the Jhelum & Rawalpindi line. The deck spans are of the Warren truss type, on masonry piers, and the new central truss is deeper than the old trusses. To permit of placing the new truss it was necessary to remove the rivetted cross-bracing and substitute a temporary bolted system of bracing, so that sections could be removed while the truss members were being placed in position, and the bracing immediately replaced and bolted. After the erection of the trusses was completed, this bolted bracing in turn gave place to a new and permanent riveted bracing, specially designed and adjusted to transfer the proper proportion of the load to the new truss.

Mainly Constructional

East and West—From Coast to Coast

The Sewer Paving and Construction Company, Montreal, have obtained a charter.

Mr. E. R. Gray, Toronto, has been appointed Assistant City Engineer of Hamilton under Mr. A. F. Macallum.

F. Benard & Sons is the name of a new general contracting firm with head office at Montreal, registered by Mr. J. E. Benard.

Twelve applications were received for the position of City Engineer of Cranbrook, B. C. The salaries asked ranged from $100 to $155.

The building permits in Quebec last month registered a gain over the figures for March, 1914. The total were $412,780 and $342,542 respectively.

There will be considerable activity in street work at Hamilton this season. Concrete pavements and curbs are to be laid on thirty streets at a cost of $22,000. The work is to be started in June.

The F. W. Thorold Company, Limited, 2 Toronto Street, Toronto, have been appointed Consulting Engineers by the Meaford Town Council in connection with the extension of the water-works system.

Messrs. Darling & Pearson, the well-known Toronto architects, have been retained by the Canadian Pacific Railway to prepare plans for the new station at North Toronto. The building will cost some $800,000.

At Calgary, recently, the local branch of the Canadian Society of Civil Engineers gave an informal dinner in honor of Mr. William Murdoch, City Engineer of St. John, N.B., who gave an interesting address on engineering works at St. John.

The city of Westmount, P.Q., are extending their new lighting system, and will now install 6.6 ampere inverted magnetite arc lamps at many cross streets. Contracts have been placed for the supply of lead covered cable with the Eugene F. Phillips Electrical Works, Limited, Montreal; cast iron standards, J. Watson & Son, Montreal; and the lamps, Canadian General Electric Company.

Mr. H. S. Van Scoyoc, Chief Engineer of The Toronto-Hamilton Highway Commission, gave an illustrated address on "Concrete Highway Construction" at a meeting of the Toronto Branch of The Canadian Society of Civil Engineers, held on the evening of April 22nd at the headquarters of The Engineers' Club of Toronto.

We have received from Mr. Norman A. Ruse, Publicity Commissioner of the city of Regina, an attractive album of views of the city. The booklet is attractively bound, and well designed and compiled throughout. It is a photographic record of the growth of Regina during the last decade—a record that is at once convincing and compelling.

With the object of facilitating the supply of road oils for binding and dust-laying purposes, The Asphalt and Supply Company, Limited, Montreal, are erecting on the Montreal harbor front three steel storage tanks, with a capacity of 90,000 barrels. A tank steamer with a cargo of 10,000 tons of asphaltic road oil is now on its way from Mexico to the port, and the tanks, two of which have a capacity of 37,500 barrels each, will be ready to receive this shipment. The Mexican Eagle Oil Company, for which the Asphalt & Supply Company are the Canadian agents, are co-operating in an effort to enlarge the business in road oils, and as the Mexican Eagle Company have a large fleet of steamers, they can easily supply all the oil required. The oil, refined in Mexico, can be pumped direct into storage cars and despatched to buyers in any part of the Dominion.

The city of Montreal have awarded the contracts for the new system of lighting on a portion of St. Catherine Street and on Bleury Street, which will result in the abolition of the present unsightly poles. The scheme provides for the installation of eighty-four 6.6 luminous arc lamps of the inverted type, on ornamental poles of special design which will be spaced 125 feet apart. G. M. Gest, Limited, Montreal, obtained the contract for furnishing and installing the standards, for $6,095; the Eugene F. Phillips Electrical Works Limited, Montreal, the cables and wiring, for $21,211; and the Canadian General Electric, the lamps, for $10,657. The electrical portion of the work will be done by the Eugene F. Phillips Electrical Works, Limited, their contract price including the supply of about 56,000 feet No. 6 B & S twin conductor paper insulated, lead covered cable and the wiring, which will be No. 6 B & S single conductor varnish cambric insulated and braided; also the cut-offs and pot heads and lightning arresters. The work will be commenced early in May.

Lt.-Col. Lacey R. Johnson, whose appointment as General Welfare Agent of the C. P. R. was reported recently in our columns, died on Saturday, April 17, at his Montreal residence, after three weeks' illness. Col. Johnson was a native of Abingdon, Berks, England, and served an apprenticeship at the Great Western Railway Works, Swindon. After three years' residence in India, he came to Canada in 1882, taking service with the Grand Trunk. Later he joined the C. P. R., and after holding various positions was transferred in 1901 to Montreal, as Assistant Superintendent of Motive Power. Eleven years later he was made General Superintendent of the Angus Shops, a position which he held until he was appointed General Welfare Agent. Col. Johnson was greatly interested in military work. He was a member of the Shell Committee, and at Valcartier he was in charge of the shell tests. In 1906 he became a member of the Canadian Society of Civil Engineers. He was also a member of the Institute of Mechanical Engineers, and a past-president of the Canadian Railway Club.

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The Cost-plus-a-Fixed Sum Method as a Substitute for Contract Work

THE award of contracts on the "cost-plus-a-fixed sum" basis, which is the subject of a recent communication, has certain phases which are worthy of comment. The advocates of this method contend that the "lowest price" is not often the best price, and that it does not represent the value that it has on paper. There may be an element of truth in this argument, but the contentions adduced further savour of the utopian: it is urged, with some reason, that the present system of competition among contractors is not wholly advantageous to the owner, while it is often ruinous to the contractor; but there are defects in every human system, and it is difficult to see how the main end—that of competition—is to be served by the "cost-plus-a-fixed-sum" method.

The communication to which we have referred comes from Mr. H. Sayward, Secretary of the Master Builders' Association, of Boston, who tells us that "competition under 'cost-plus-a-fixed-sum' is competition 'before the fact'—that is, before the owner comes forward with his proposition to build." This is a peculiar statement, and it is none the more lucid by virtue of its association with a legal quibble. Can any one imagine competition after the fact? In explanation, Mr. Sayward proposes that builders should "demonstrate" to the prospective owner what they have accomplished in the past in the way of economical, speedy and effective work. "In this way," he says, "there will be a very real competition, in which builders will vie with one another for the favour of owners who are to build in the future. Likewise there will be a notable cutting of costs to the owner—and it will be a cost that will stay cut, because there will be no temptation to 'skin the job' in order to avoid loss on the contract."

An Appreciation from Holland

Rotterdam, April 19, 1915.

Editor Contract Record:

The Empire Number of The Contract Record and Engineering Review is a most valuable publication, and will be very useful as a book of reference. I have read many of the contributions with great interest—notably those by the Honourable the Minister of Trade and Commerce and by the Commissioner of Commerce.

Yours faithfully,

J. T. Lithgow,
Canadian Trade Commissioner.

To our mind this argument is absolutely unsound, and it is astonishing to find it advanced by those who lay claim to speak with authority on contracting matters. What Mr. Sayward advocates is a sort of competition of reputations, without the consideration of dollars and cents—a hopeless proposition. Reputation is a common factor in both cases, so that under the "cost-plus-a-fixed-sum" system building contracts are removed from the active area of competition, and the field is thrown open to untold malpractice on the part of the architect—and it is quite as necessary to keep a close eye upon the architect as upon the contractor. Collusion between architects and contractors has been an endless source of trouble in the building business.

We are told of a contractor who effected a saving of seven cents in cost per cubic foot of brick laid by improved methods of transporting the material to the stagings. This may have been done—we should like to know how—but it is hard to accept the statement that such a reduction of cost "would seem to be particularly a development of the 'cost-plus-a-fixed-sum' method." Surely there is far greater incentive to such economies in ordinary competitive work, where the contract price is a fixed quantity.

Whenever anybody comes forward with a departure from established rule he makes a mistake in trying to build up the new system by pulling down the old. It is no special recommendation for the "cost-plus-a-fixed-sum" method that under the contract system "a careless, indolent or unscrupulous contractor is open to the temptation to save himself or add to his profits by skimping work and materials, by 'skinning' sub-contracts, or by other such practices, rather than by cutting the cost through improved methods." Such statements build up a wall of prejudice which makes it impossible to discern virtue in the alternative proposition—though it may have some.

The very foundation of contract work is reputation. In these days of keen competition, especially, one might paraphrase the old saying into "Give a contractor a bad name, and hang him." A man with a building proposition to put through would be addle-pated indeed were he not to give the greatest consideration to the reputation of the men he employed—first and foremost the architect, and then the contractors,—the select few upon whom one can always rely for an honest job, put through on a scientific basis of economy and efficiency.

Rogues, like the poor, we shall always have with us; but we can see their number multiplied by the substitution of the "cost-plus-a-fixed-sum" method for the contract system.

Concerning Annual and Other Reports

It is common knowledge that in an architectural competition to be judged by laymen an attractive, easily understood picture usually wins over a plain, uninteresting drawing, despite the fact that the latter may present much the better design, comments The Engineering Record. Engineering works frequently do not lend themselves to pictures made by either pencil or camera. Consequently, word pictures become the more important. Whether describing work done or to be done, whether annual or special, that report will be most successful in winning approval which first arrests attention, then holds interest by a sequential, live and logical development of the subject, and finally leaves in the reader's mind a clean-cut, comprehensive idea of the project, with the most important elements standing out in relief, in proper relationship.

Successful report writing demands an imagination which can work from the viewpoints of the probable readers, and which, therefore, can perceive the features which will interest them, and conceive ways for putting life into the "deadly uninteresting." To this end a rich vocabulary, precise diction, intelligent discrimination in the use of words, and skill in arrangement of chapters, paragraphs and sentences, all contribute. Native deficiencies in these directions can largely be made up by painstaking work. Too frequently unimportant ideas or words are carelessly allowed to fall into prominent positions. Involved and incoherent sentences and tedious sameness of expression destroy interest. Poor English is an unfit vehicle for presenting good engineering.

Illustrations have much to do with the success of some reports. If photographs, they should be good pictures as well as making plain the subject to be brought to the readers' attention. Titles, while concise, should be sufficiently complete to bring out the full value of the picture. In some cases explanatory matter beneath the title is desirable. These suggestions will apply also to maps and other drawings. In drawings common faults are overcrowding—seeking to show so much detail that after reduction clearness is lost—lack of relief by failure to use lines of different weights to give prominence to the main features and subordinate the minor, and lettering so small that after reduction it is illegible, or, at best, discouraging to most eyes. Each illustration, if practicable, should be placed near the text to which it is related.

Typography, also, is important. A clean, easily read text often may be displayed to advantage by suitably balanced chapter, page and paragraph headings. Such headings, if skilfully used, are valuable aids in catching attention and in finding information sought. Titles of tables should be complete and accurate, and column headings, while brief and even abbreviated, should not leave the reader in doubt.

But annual reports are not written and printed solely for the outsider. Not infrequently they are the most surely permanent record and the most convenient reference book for use in the further conduct of the work. These uses should be kept in mind in their preparation, but the annual report should not be burdened with matter which rightfully belongs in a manual of instructions for employees. Details, too, belong in appendices, not in the main report, while tabular matter relating to routine matters should remain in the record books of the department.

Primary facts are all too commonly left unstated. A report writer having progressed far into the details of the work sometimes loses his perspective and forgets that information which long ago became part of the subconscious groundwork of all his thinking has not yet been imparted to his reader, yet is fundamental to a correct understanding of the more detailed statements.

Once in a while a report has to be searched for its date, which ought to be in a conspicuous place, and occasionally the outside of the bound book does not display conveniently the name of the community or department. A serial number placed on the back is often useful for reference. A distinctive, pleasing color for the cover is worthy of consideration. More frequent use of good colors would break the monotony of dull, funereal black which dominates some libraries of engineering books. Enough has been written in the past about standard size to warrant silence here on that detail of the subject.

Some of the suggestions which are pertinent for a large city or department do not, of course, fit a small town ,but in any case a report should be suitable for its purpose and its readers, and should do justice to the work to which it relates. If the purpose be clearly borne in mind and precedent disregarded the improvement would be immediate. Such improvement is earnestly to be desired to the end that the public at large may be more interested than in the past in the works for which it is called upon to pay.

War Contracts Increasing

MANY of the smaller industrial plants are profiting by the War. For example, we hear that the Fisher Motor Company, of Orillia, have a contract which means turning out six hundred 3-inch shells a day for several months. Their factory is now running twenty-four hours a day. Then from Seaforth, Ont., we hear that the Bell Engine Works are running night and day on orders for shells, and that they are making enterprising arrangements in regard to staff and equipment so as to be able to execute additional contracts which they have received.

Ontario has had a generous share of war orders, but, as a matter of fact, the contracts are distributed pretty evenly. From a New Glasgow, N.S., communication we learn that the Nova Scotia Steel and Coal Company, the Eastern Car Company, the Canada Tool and Specialty Company, the Eastern Steel Company, and the Maritime Bridge Company all have large contracts.

The Ross Rifle Company are said to be making five hundred rifles a day, and paying a wage bill of $25,000 a week.

The war has its compensating features.

Sam Hughes Speaks

LAST week, in the House of Commons, the Minister of Militia for once made a statement worthy of note. This was that arrangements were now being made whereby Canada would refine her own copper, purify her own zinc, and manufacture her own brass for war munitions. In this connection it is of interest to report that an investigation which has an important bearing on the manufacture of shells has just been concluded by Dr. Alfred Stansfield, Professor of Metallurgy at McGill University, Hon. Col. David Carnegie, of the Shell Committee in Canada, and Dr. A. W. G. Wilson, of the Mines Branch, Ottawa. These gentlemen have just returned from a three weeks' tour of Western Canada, where an investigation was conducted with a view to establishing a copper refinery and zinc reduction works. At present all the copper mined in Canada has to be sent to the United States to be refined, and the same thing applies to the zinc ores. If the refining and smelting can be done within the Dominion it will be a great achievement for Canada, not only from the military standpoint, but commercially.

A good report is to hand from Mr. M. H. MacLeod, General Manager of the Canadian Northern Railway, who has just returned from a trip through western Canada. Mr. MacLeod is particularly impressed with the favourable outlook. He tells us that the crop prospects are excellent, and that there is a much larger acreage under seed. His own company has made plans for carrying out extensive construction this season. All the details have not yet been completed, and a definite announcement will be made shortly. A large number of men are to be put at work on the main line in the West.

Berlin's Offence

MUNICIPAL councils throughout Ontario should take an awful warning from the experience of the city of Berlin, whose City Council have received an ultimatum from Dr. McCullough, Chief Inspector of the Provincial Board of Health, giving them until November 10 to install an efficient sewage disposal system. Some years ago the civic authorities there put in a sewage disposal plant, but they neglected to provide for the increasing amount of sewage created by numerous large industries and the growth of the city—with the result that the filtration beds have been overworked, and raw sewage has been entering the creeks and streams. The plant was designed for a capacity of 650,000 gallons, and the present flow is estimated at 2,000,000 gallons. Since 1906 the only additions to the plant have been three acres of sewage beds, increasing the previous capacity by about 125,000 gallons.

Such a state of affairs reflects little short of criminal negligence, and it is to be hoped that the provincial authorities will make an example of the town with the German name, and see that the law is not being transgressed similarly by other municipalities.

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By the way, one would hardly expect a town with such a name as Berlin to have an efficient sewage disposal system. It is a matter for astonishment that the authorities do not change the name of the place. "What's in a name?" the Immortal Bard says; and at a time when every English-speaking community is giving its best blood for the preservation of British ideals we reply, "A great deal, when it reminds us of anything German." We have the example of Russia: there is no longer a St. Petersburg; it is now Petrograd. Why should Canada tolerate a Berlin and a Prussia, a Dresden and a Breslau, a Bismark and a Holbein, a Holstein, a Heidelburg, and a dozen others of the same ilk? We are quite ready to absorb good German citizens, but it is infamous for Canadian towns to bear German names. This is a matter more for the daily press than for the technical press, but just the same it is a matter for every right-minded citizen with a British backbone in him.

Wanted—Reliable Cost Data

NOTHING is sought more keenly by technical papers than costs first, costs second and costs last. But few engineers are willing to make public this information in detail, and still fewer executives will sanction such a course by a broad-minded subordinate.

A stock objection raised by the operator, when costs are requested, is that such figures would be of no use as a guide to others. And then our old bugaboo, "local conditions," is trotted forth with all impressiveness of the stuffed lion in a Christmas pantomime. Of course, it is not pretended that figures are everything. In fact, figures offer only a starting point; but a starting point we must have.

The objection to giving out costs has lost much of its force in view of the detailed accounting data that must now be filed with public utility commissions.

Many of these data are available to anyone who cares to copy them; but unless the corporation is willing to aid in their interpretation, the most misleading conclusions may be drawn, for in the broadest sense the word "costs" must be understood to include an explanation of accounting practices and engineering standards.

Apropos of misinterpreted figures, a certain engineer protested quite vehemently at a published comparison with his costs as taken from a Government publication. Yet a few months before the same engineer refused to permit the publication of a descriptive article, with costs, that would have placed the practices of his company in a more desirable light.

In short, engineers and executives should give up the idea that they lay themselves open to attach when they permit costs to be published. The unmistakable trend of the times is toward publicity; and as with liberty, the evils of publicity are curable by still more publicity.

It is pleasing to learn that an early start is to be made on the summer's work of road building in New Ontario, for which the Provincial Government has provided $615,000. Of this sum, $90,000 will be spent on the highway along the T. & N. O., $75,000 on a road along the Transcontinental, and $50,000 on a trunk road from Sturgeon Falls to Sudbury. The rest of the grant will be apportioned among the other districts of New Ontario.

The Construction of the Mount Royal Tunnel for the Canadian Northern Railway

Specially contributed by **J. L. Busfield, B.Sc.**[*]

CONSIDERABLE progress has been made in the various stages of the construction of the Mount Royal Tunnel for the Canadian Northern Railway, and some portions of the work have been practically completed. The undercrossing of the Canadian Pacific Railway at the west portal is complete with the exception of certain final touches, part of the tunnel lining has been built in open cut, and only a small percentage of rock remains to be excavated.

C. P. R. Undercrossing

At the west portal of the tunnel the Canadian Northern tracks pass under the Canadian Pacific Railway with a difference in elevation of twenty-five feet, and immediately east of this crossing the Canadian Northern Railway "Portal" station has been built. The platforms of this station extend below the Canadian Pacific Railway, so that in designing the undercrossing provision had to be made for two tracks and two platforms. The traffic on the Canadian Pacific tracks being comparatively heavy, special attention was paid to making the design of such a nature that an absolute minimum of interference would be made with the Canadian Pacific Railway trains during the various stages of construction, and this was obtained by adopting the section shown in Fig. 1, which consists of four spans covered with flat reinforced concrete slabs.

Design

Between the two tracks (15 ft. 6 ins. c. to c.) is a centre wall, acting as a support for the main roof slabs. This wall is 18 inches thick, and is reinforced in each face with vertical bars ¾ in. square and 12 ins. c. to c., and with horizontal bars ¾ in. square and 2 ft. c. to c. The base of the wall spreads out into the footing, which is founded on rock, and contains the electric ducts and conduits. (See Fig. 1).

The space on either side of the centre wall is divided into two spans, respectively 6 ft. 9 ins. and 13 ft. 6 ins. clear, by a longitudinal reinforced concrete girder supported on columns situated on the platforms, spaced 10 ft. 4¼ ins. c. to c. The girders spanning the columns are 4 ft. deep and 2 ft. wide, and are heavily reinforced. The roof slabs spanning from the centre wall to the girder are 15 ft. 7 ins. long, 2 ft. 3 ins.

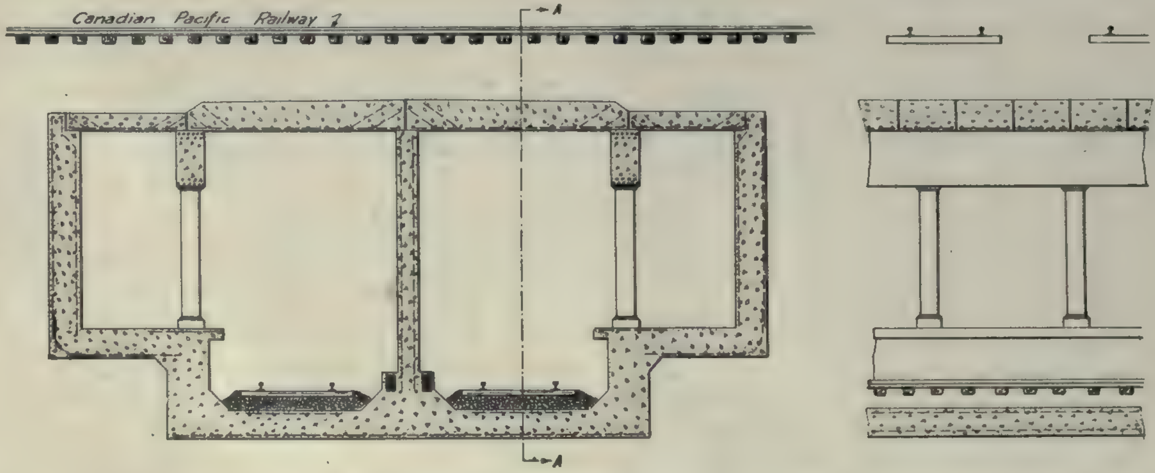

Fig. 1—Section at C. P. R. crossing, with reinforced roof slabs.

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[*] Assistant Engineer Montreal Tunnel and Terminal Construction.

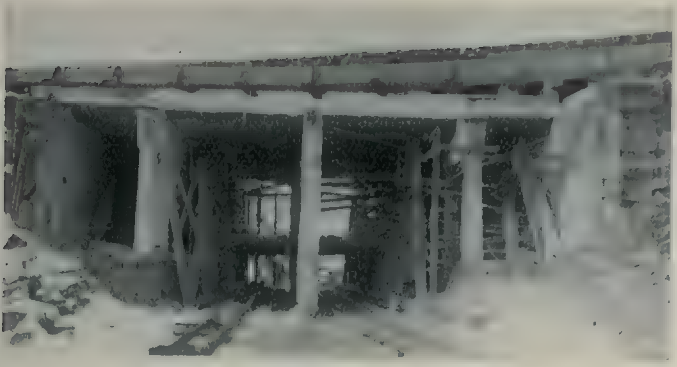

Fig. 2—View of C. P. R. crossing, with roof slabs in place.

deep, and 4 ft. wide, and are heavily reinforced. These slabs weigh about ten tons each, and are provided with stirrups of 1-in. square bars set in slots for handling purposes. A slab 15 ins. thick is used to span from the girders to the side walls, and is 10 ft. 4¼ ins. long and 8 ft. 2 ins. wide, and weighs approximately eight tons.

The side walls, platforms and foundations are all adequately reinforced with ¾-in. square bars. Joints are provided in the footing course so that the centre walls and columns are brought to their foundation independently of the tracks.

It will be noticed that a departure has been made from the standard Canadian practice in providing high platforms, level with the car floors. As the traffic at this point will be almost entirely local, and will be handled largely by the multiple unit cars, the time taken in loading and unloading the trains will be reduced to a minimum, and the inconvenience caused passengers by their having to climb down car steps will be eliminated.

Construction

As the excavation for the undercrossing proceeded piles were driven, and the Canadian Pacific Railway tracks were supported on falsework consisting of timbers and steel girders. When the necessary foundation had been prepared the concrete footings were poured, and the work carried on in stages until the centre wall, girders, and side walls had reached the level of the under side of the slabs. The tops were all levelled off preparatory to receiving the roof slabs, which were being made in the yard and allowed to set and season. The side walls were provided with expansion joints consisting of three-ply waterproofing fabric about 18 ins. wide. This was made up of two-ply roofing felt, with one-ply burlap on top, all plies saturated and mopped down with coal tar pitch. The rear surfaces of the side walls were mopped over with two coats of coal tar pitch. In Fig. 2 is shown a view of the crossing with the roof slabs in place. The flume in the top foreground carries the Canadian Pacific Railway water across the excavation.

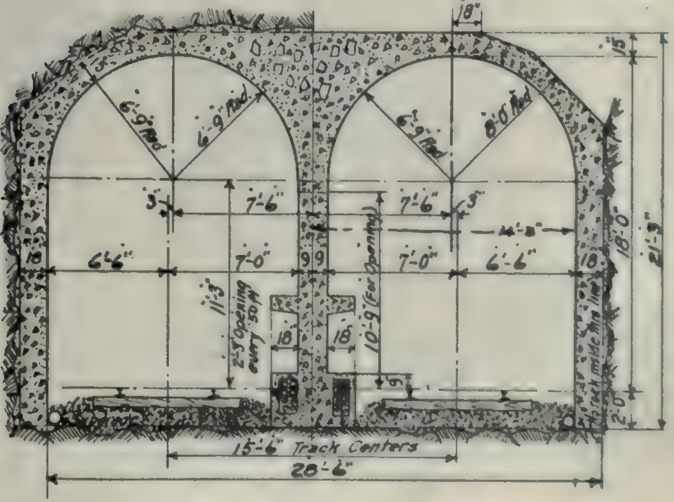

Fig. 3—Tunnel section as built in open cut.

Although there are only three tracks on the Canadian Pacific Railway at this point, the undercrossing has been built to accommodate the ultimate capacity of the right-of-way, so that the walls and girders projected to a considerable extent outside the limits of the existing tracks. This enabled the roof slabs to be set in place with very little disturbance to the trains on the main line tracks, as the slabs were all handled by means of a derrick car on the siding which placed them on to the bridge seats between the siding and the main lines. The slabs were then pushed along to their final position and the load transferred to them by blocking and timbers under the tracks. The slabs all being in place, the joints were grouted ready for waterproofing. The concrete throughout the work was proportioned one of cement to six of aggregate.

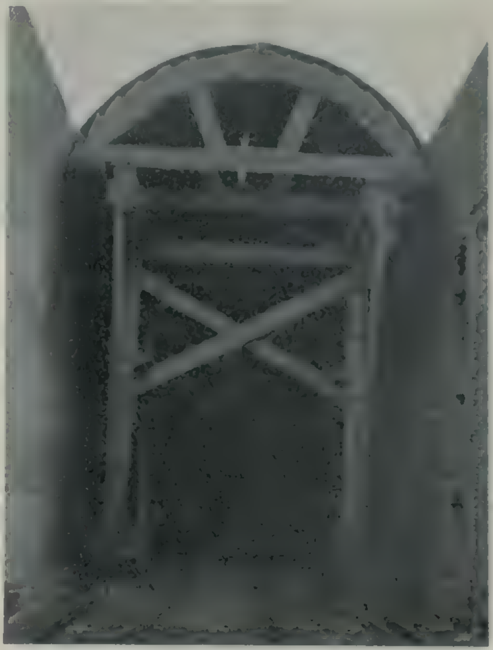

Fig. 4—Portable forms and form carriage for open cut section.

Open Cut Section

For a short distance east of the Portal station the excavation for the tunnel was made in open cut, on account of the small depth of cover and the character of the ground. The concrete tunnel lining being built in this cut conforms to the section shown in Fig. 3. After this is completed the hole will be filled in again and the streets of the Mount Royal Heights subdivision built on the surface. The method of constructing the lining has been to place forms for the side walls to a height of about one foot above the springing line for the arch. After these walls were set and the forms were removed the crown was built in short sections, using a portable form (see Fig. 4) supported on a form carriage running on a special track of 8-ft. gauge. The forms were blocked up on the carriage to their correct position, and when the concrete was set the blocking was knocked out and the forms lowered into the carriage and moved to their next position. The concrete for this portion of the work is made in a Ransome mixer with a capacity of 1 cu. yd. The arch is designed to withstand the full pressure of the earth between the roof and the surface, together with the live load which may be transmitted from heavy vehicles on the surface.

Shovel Excavation

The preliminary excavation of the tunnel having been carried out by means of headings and break-ups, the two side benches, containing about 8 or 9 cu. yds. of rock to a lineal foot, are being excavated by means of a Marion steam shovel with a 1¼-yd. dipper (see Fig. 5). This shovel is operated by compressed air supplied from the compressor plant. In order that its work may be continuous and free from interruption due to blasting, etc., the benches are drilled and blasted into for some considerable distance ahead of the shovel. The rock is loaded into muck cars on the 3-ft. gauge work track, and hauled to the portal by 10-ton electric locomotives. The rock is passed through the crusher plant at the west portal, and distributed into the bins and stock piles (Fig. 6) for use in building the streets of the Model City and for concrete work within the tunnel.

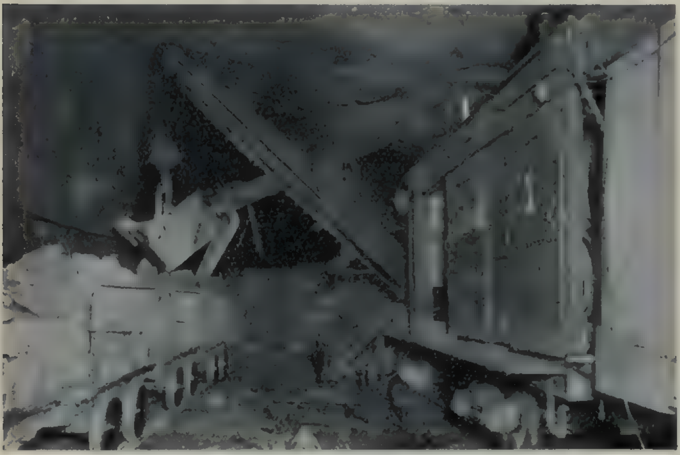

Fig. 5—Marion steam shovel at work removing benches.

An interesting piece of legislation has just been passed by the province of New Brunswick. This is an Act for the prevention of smoke and noises in towns and cities. The Act gives local authorities permission to make by-laws regulating or prohibiting the ringing of bells, the blowing of whistles, and the emission of smoke from chimneys. The maximum penalty is a hundred dollars.

Moving a Steel Water Tower

Contributed by C. E. Henderson, City Engineer's Department, Port Arthur, Ont.

RECENTLY the Ogilvie Flour Milling Company, Limited, who have a large flour milling and elevator plant in Fort William, found it necessary either to remove to a new site or tear down and reconstruct their water tower and tank, on account of the 250,000-bushel addition to their elevator which was under construction by Messrs. Barnett, McQueen Company, elevator contractors, of Fort William. They chose to remove the tower intact, and the steel tower, 120 feet high, supporting a 50,000-gallon water tank, was successfully moved a distance of two hundred feet by Messrs. Beaton & McLeod, contractors, Fort William.

The new concrete foundations were first constructed at the new site before the work of removing the tower was commenced. On account of the value of the tower and nearby buildings and the large force of men working on the elevator addition, it was necessary, before the old anchor bolts were loosened, to secure the tower against tipping over. To do this the top of the tower was anchored in four directions by ¾-in. steel cable. As the tower was moved the cable was carefully played out, or taken up, by means of a set of falls at the lower end of each guy. The feed pipe and frost box in the centre of the tower were supported securely by means of cross timbers between posts, and also by means of cables swung underneath the timbers at the centre and attached to the posts at a higher point.

The four posts of the tower, which were thirty feet apart on each side at the base, were made up of two channels each. To these posts were bolted 8 x 16-in. timbers, forty feet long, which were used in jacking up the tower before placing the skids and rollers under it. The track was composed of 12 x 12-in. timbers placed on the frozen ground and carefully levelled up with blocks. The skids placed under the tower posts were two 8 x 14-in. timbers, forty feet long, each having two maple shoes, 3 x 12-14 feet. The rollers were of

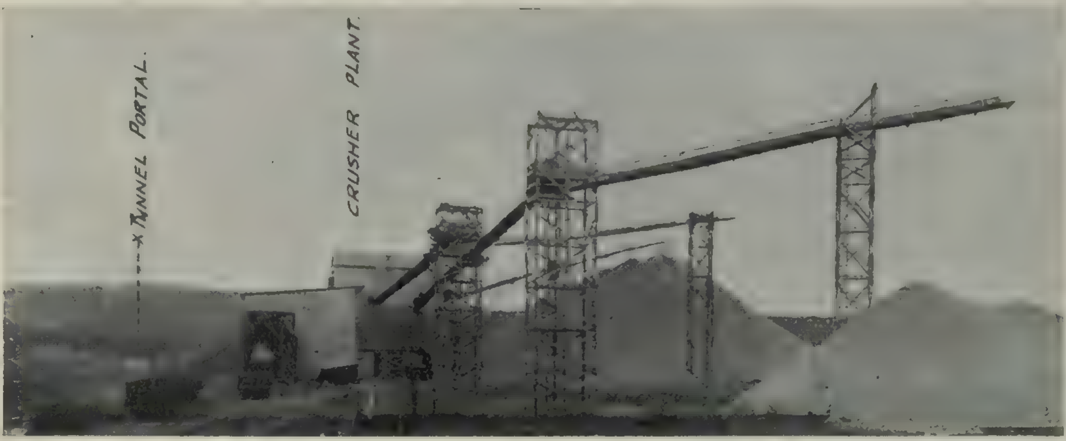

Fig 6—General view of west portal, showing crusher plant and stock pile.

maple, seven inches in diameter and six feet long. Transverse timbers, 8 x 14 ins., were used to keep the tower posts from spreading.

Power for hauling was furnished by a team attached to a ⅞-in. rope, which worked through a pair of double blocks. This tackle was used as a luff on the main ¾-in. steel cable, which worked through a pair of triple blocks.

Seven men were employed, and the entire operation, excepting the construction of the new foundation, required about five days. The actual time of moving, however, was only three and one-half hours.

Arrangement of Scow Bridge for Building Falcon River Dike, Winnipeg Water District

REFERRING to the description of Cook Construction Company & Wheaton Bros.' method of building a rock-fill breakwater at Halifax by using a dumping bridge whose outer end is supported on a scow, M. V. Sauer mentions that the same method was used in the Winnipeg Water District to build a diversion dike on Falcon River. The distinctive feature of the Halifax case, however, was the use of the dumping-bridge-and-scow method in tidal water. This required that the scow be arranged with ballast compartments and pumps, so that it could be kept at the same height with respect to the breakwater as the tide rose and fell. The Halifax contractors worked in a 6-ft. tide with no trouble by this method. At Winnipeg there was no tide to complicate the problem.

The details of the Winnipeg arrangement are interesting. When bids were called for, the engineers of the water district suggested that the scow method be used; nevertheless, all bidders but one figured on dumping from a trestle. Tomlinson & Fleming, the successful bidders, saved over $25,000 to the district by using the scow method.

The contractors used two scows in tandem. The track on the boats consisted of 90-lb. rails on a framework whose sills rested on, but were not fastened to, the deck. To move forward, the scows were outhauled under the rail-supporting frames by a cable passing forward over a snatchblock at the outer end of the rail and back to the dinkey. Then the inshore ends of the 90-lb. rails were moved to the outer end of the scows in the new position, and the gap filled in with the regular 60-lb. rail as used in the rest of the supply track on the finished fill.

The dike, 8,000 ft. long, containing about 230,000 cu. yds. of gravel, progressed rapidly, being practically completed in four months. The greatest depth of water was about 25 ft. Material was obtained from a gravel pit adjacent to the north end of the dike.—Engineering News.

One of the stands at the Chicago Cement Show this year contained some particularly interesting exhibits illustrating the durability of concrete. The most remarkable among these were sections of concrete from the ancient Roman cities of Pompeii, Rome and Colon. A piece of concrete cut from a bridge pier in Nova Scotia, and subject to continuous tidal action ever since the year 1884, showed how well concrete is able to withstand the most trying conditions. Another exhibit consisted of a piece of concrete sewer pipe 45 years old, taken from the Bay City sewer, Michigan, in the course of recent extensions. Other specimens of similar character were a 47-year old piece of sewer pipe from South Bend, Indiana, and part of a street crossing laid in North Dakota, fifty-one years ago.

Carrying a Sewer Beneath a Canal Embankment

To carry a sewer beneath a canal embankment which rested on running sand at Rochdale, England, the invert of an existing culvert beneath the canal was replaced by a hollow cast-iron invert which has since served as a sewer. The culvert was of elliptical section, 8¾ ft. high by 7½ ft. wide, "formed of four half-brick rings," to quote from the London "Surveyor." The hollow cast-iron invert blocks were made of a special form, equal in sectional area to a 24-in. circular pipe. Each 2-ft. length of block weighed about 1,400 lbs. To give a solid foundation to the cast-iron invert sewer, as it may be termed, "finely ground liquid lias lime grout" under air pressures up to 60 lb. was forced into the sand through holes drilled in the brick invert of the culvert. After allowing time for the grout to set, the brick invert was cut out in lengths not exceeding 2½ ft. A few inches in depth of the grouted sand were then replaced by "fine cement concrete," shaped by means of a template and rammed down. The hollow invert blocks were then placed. The spaces between the iron block and the remaining portions of the brick invert were filled with a 1:1 stiff cement mortar and calked with an iron tool, as were also the V-shaped joints between the ends of the iron castings—the faces of the latter having been planed and fitted.

Suggestions for Constructing Street Railway Tracks

IN the concreting of modern street railway track construction steam cinders make a good, cheap concrete with a 1:3:6 mix, but too often it is necessary to use more sand and cement, reducing the proportions to 1:2:4, on account of the quality of the cinders, writes S. Gausmann in The Engineering Record. Unless these cinders are obtained free, the cost of the concrete will be nearly as much as if gravel or stone is used, and yet it will be inferior in quality to mixtures containing the latter elements. A 1:3:6 mixture containing either stone or washed gravel, preferably the latter, is most desirable in modern track construction.

One of the causes of failures in paving is that when the concrete is placed in the track it is often too wet, thereby undermining the bed of the ties and causing the track to "pump." Concrete with an excess of water should be avoided, especially where operation is resumed over track immediately after the concreting is finished and before it has had time to set.

Another condition to be avoided is the failure to compact the concrete thoroughly under the rail. While with an exceedingly wet concrete this space will be filled at first, the concrete will soon shrink away from the rail, leaving a void which is not large in extent, but large enough to do damage. On the other hand, when the concrete is of the proper consistency a large pocket will be left unless extreme care is used. To avoid this trouble the concrete should be thoroughly placed by shovel tamping, followed, after it has set slightly, by tamping with tamping bars from both sides of rail. Unless this is done sand from below the paving will work into the pockets and cause the pavement to settle, especially along the rail.

When track is concreted from the bottom of the ties to 3 ins. or more above the ties it is advisable to do so in two sections, bringing the first section to the top of the ties, and placing on this a very thin layer of sand, followed by the rest of the concrete. While this separation may seem to be added work it can be done at no greater expense than if the concrete was placed all at once; it will not injure the quality of the foundation, and although the "other fellow" possibly is not considered the two-section practice means much good to the road when reconstruction is undertaken.

The Human Element in Contracting*

By L. C. Watson†

AFTER learning that there is a prospective job, a member of the company investigates its character and location, to determine whether it is within the company's specialized work, and whether it is desirable. He then meets the owner, if possible, to interest him and to size up his temperament and business methods.

The Owner

As sometimes the owner takes an active interest in the execution of the work, although he deals through his engineer or architect, it is of considerable importance to know his temperament and point of view. Greater harmony will thus be obtained. The engineer will do well to bring both parties together early and often. There is the owner who has not been seen at the time of final payment, and there is the one who is in evidence every day; there is the one who has a technical training and knows, and there is the one who does not know about construction, but thinks he does, and personally mixes into the work commonly considered as the engineer's. If the engineer is weak-kneed with the last type of owner, expense and misunderstanding are almost certain to result—primarily because no man can serve two masters, and secondarily because an ignorant master, the owner, is never satisfied. If there is a strong, fair-minded engineer who commands the respect of his client, there is little trouble with any type of owner.

It is necessary to study the engineer or architect, and consider his method of handling and supervising work. The methods of some engineers are radically different from those of others, and this has a marked bearing upon the cost of the work, and sometimes on its desirability to the contractor. The contractor must determine what sort of treatment he will receive. Nothing adds to the price of a bid like uncertainty, whether it be in the temperament of engineer and owner or in unknown construction problems.

In one case where a number of local firms were invited to bid on a certain large building for an architect who was well known always to rule in favor of his client, irrespective of the merits of the case, the successful bidder, after figuring full measure on all quantities, added this item—"Humor architect." The item was 10 per cent. of the contract. It is safe to presume that all other competitors placed this contingency at a higher figure. Such a man could not get a reasonable bid from anyone who knew him, and certainly he could not expect to let work advantageously to guileless strangers. An engineer in a distant city, whose reputation has reached beyond the limits of his activities, has a personal equation of 25 per cent. plus. The best information available indicates that these men do not personally profit in any way improperly in this excess cost. Instead of being wise and just judges between the two contracting parties, they are simply over-zealous partisans. Fortunately, this class of architect and engineer is very small, and their influence on industry still smaller.

The largest class is that in which the engineer or architect intends always to be just, but on rare occasions allows his judgment to be influenced by the attitude of the owner; or, where two different solutions may be possible, for policy's sake or for hope of personal advancement, makes the second best decision. This increased expense which is entailed can never be foreseen, although it certainly exists, and has to be paid for as a contingent item of cost. The reputation of the engineer who is always fair spreads far and wide, and he is sought out by many responsible contractors who desire to do his work. This results in work being done at the lowest legitimate cost by competent firms. The owner gets a square deal and recommends his friends to employ this engineer, who in the long run prospers more than he could by other methods. Meanwhile, he maintains his self-respect and is proud of work well done.

Contractors talk rather freely among themselves about their experiences and their opinion of those for whom they have worked; and, perhaps oftener than is imagined, they are asked by owners whom they would recommend to design new work. Certainly they exert an influence on the reputation and on the business of the engineer.

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* Extract from a paper read before The Boston Society of Civil Engineers.

† President Aberthaw Construction Company, Boston, Mass.

American Engineers in Charge of Belgian Relief Work

TWO American engineers are mainly responsible for the efficient manner in which the Belgian relief work has been carried on. One of them, Lindon W. Bates, had retired from active practice after more than thirty years of engineering work, but willingly returned to labor nineteen hours a day without compensation as Vice-Chairman of the Commission for Relief in Belgium in organizing the work in the United States. The other, Herbert C. Hoover, stopped short in a noteworthy career to act as Chairman of the Commission, handling the work of distribution in the afflicted country.

Despite the fact that in the beginning it was emergency work, undertaken under most adverse conditions, there has been no hitch in the arrangements from the very beginning until the present, when the work is being carried along in almost machine-like fashion. A populous nation has been clothed and fed, largely by voluntary subscription. The innumerable small packages that had to be collected, transported and distributed can scarcely be imagined,and the countless details of arrangement and organization that had to be perfected to do it can hardly be visualized, for, it must be remembered, the donations came from all parts of this country, from the smallest hamlets and from the largest cities. Over five million dollars have been paid out from the New York office in cash, or check, each month, totalling at the present time over $40,000,000.

Deterioration and Decay in Timber

How Rotting Wood Has Endangered Various Forms of Construction in Canadian Practice—An Interesting Discussion at Montreal

DECAY in Timber was the subject of a discussion at the closing meeting of the Canadian Society of Civil Engineers, Montreal, on April 22. The subject was discussed from the engineering, botanical, chemical, biological, and other viewpoints by several speakers, their remarks being illustrated by a large number of lantern slides, showing the causes and effects of various forms of dry rot. The attendance was large, and included several prominent local architects, chemists and builders, and many consulting engineers.

The discussion was opened by Mr. Frederick B. Brown, M. Sc., M. Can. Soc. C. E., who said, in part:

During the last three or four years there have come into more or less prominence a comparatively large number of cases of decay in timber, causing structural difficulties. Timber is and will continue to be used in engineering work to such a very great extent for poles, piles, ties, cribwork, trestles, flooring, sheeting, and for the framework of buildings and other structures, that these cases of dry rot trouble seem to call for careful thought on the subject. Every engineer who has been connected with railroad work and pole line construction knows the effect of decay on ties, on the butts of poles and on other timbers partly embedded in the ground. But it is not so well known why adjacent ties or poles may act quite differently in resisting decay. The details of decay in buildings, however, are perhaps not so familiar to us as engineers, and it is therefore the purpose of this talk to present some features in connection with dry rot in buildings.

Decay in wood was supposed formerly to be a slow chemical action something like the rusting of metals, and it was thought that the fungus growths frequently found on timber were there because the wood was already decayed rather than because they were actually the cause of the rot in the wood. Forty or fifty years ago careful investigation in Europe showed that fungi were the cause of rot instead of the result of it, and the mycelium, or thread-like branches of the fungus, was shown to be capable of penetrating and destroying the wood fibre. There are several fungi which may cause rot in timber. Some of these varieties are now well known to botanists, but others are much less so. The action of the same fungus on different woods, and of different fungi on the same wood, is only commencing to be studied, but it is known that the same fungus acts very differently on different woods—and, indeed, on different parts of the same piece of timber. In addition to the life progress of the fungus through the wood cells, it is quite likely that there is a chemical action, but this is by no means well understood yet.

The pines—white, red and yellow—are the timbers most usually found in the framework of eastern mill and factory buildings. Spruce and hemlock also are used very largely, but not to such a great extent as the others, and oak beams have been used very freely in the past. The use of British Columbia or Douglas fir for framework is really only commencing in the east, but it is probable that this magnificent wood will be used more freely in the future, especially when the advantages of the water-borne freight via the Panama Canal shall have become well known. A very common form of construction is a framework of yellow pine with floors of spruce. The most noteworthy cases of dry rot in the last few years are concerned with timbers of nearly every variety mentioned. Apparently the disease is no respector of species. Neither is its action confined to any one locality: serious cases are on record in widely scattered places in Canada and the United States.

Structural Defects and Rot

Some four or five years ago we had occasion to examine nearly two score of water-tank structures in and around Montreal with a view to reporting on their stability. It may surprise some of those present to hear that in nearly every instance there were found one or more serious defects in design, construction or condition. Apart from structural defects, we found several more or less affected by rot.

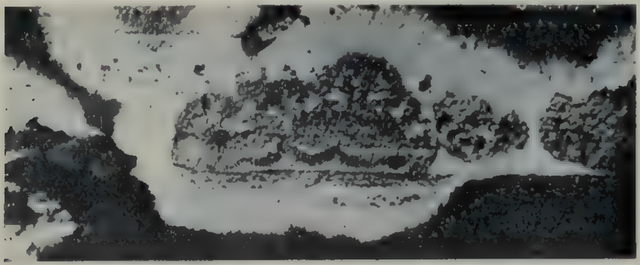
One case will serve as an example. In this one the entire wooden supporting framework was badly rotted and so dangerous as to require complete renewal. The arrangement of the structure was such that it was exposed to moisture most of the time, and an ample supply of condensed steam was available for the rot, which had penetrated nearly every member. This structure was composed of heavy white pine timbers. A not uncommon trouble was found in tank staves. These are generally of 3-in. stock. The heart of staves may be completely rotten without there being any external indication of such a condition.

A Montreal Factory

An interesting case has just come to our attention. A large factory built in 1911 near Montreal has recently been awarded a contract for the manufacture of shells for the war. In examining the building with a view to remodelling it to take certain new machinery it was noticed that the main floor had sagged. Investigation showed a serious case of dry rot, with extensive structural damage. The floor was composed of three thicknesses of 2-inch hemlock planks laid criss-cross, and the beams were 12-in. x 12-in. composite members made up of 2-in. x 12-in. hemlock planks spiked together. The floor was laid from two to four feet above the bare ground, and the beams were supported on concrete posts. There was no covering over the ground beneath the floor, nor were any openings provided. The entire floor and the beams were rotted, and were replaced by concrete.

Another case is that of a mill building. The main mill is a brick building with wooden framework, floors and roof. Taking a typical cross-section of the factory, we have a building five storeys high, about eighty-five feet wide, and about two hundred and fifty feet long. It is divided crosswise into four bays, separated by three rows of columns set about 21 feet apart. On the columns were set 8-in. x 18-in. yellow pine beams in pairs, except in the top storey, where the beams supporting the roof were single and were 8-in. x 16-in. in section. Each pair of beams was made up of two 8-in. x 18-in. yellow pine sticks held 1-in. apart by means of white pine spacers. The beams were fastened together by iron bolts passing through both beams and the spacers.

The columns in the factory were of cast iron in the first or ground storey. In the second, third, fourth and fifth storeys the columns were of yellow pine, square in section, and bored down the centre. In the second storey they measured 13¼ inches square, while in the three upper flats they were 11¼ inches, 9½ inches and 7¼ inches square, respectively. The flooring itself is the usual form of composite mill construction, made up of 2-in. x 5-in. spruce, set on edge, and of random lengths spiked side by side, running at right angles to the beams. The floors are finished on top over a layer of tar paper with 1-inch spruce on which is a hardwood wearing surface. There were twenty-one bents in the building, giving a total of two hundred and fifty-two wooden columns and seven hundred and fifty-six beams. All the timber beams and columns had been covered with a white linseed oil paint on the exposed faces.



Merulius lachrymans, or dry rot, with fruit, on beam removed from cotton factory. Scale one-third natural size.

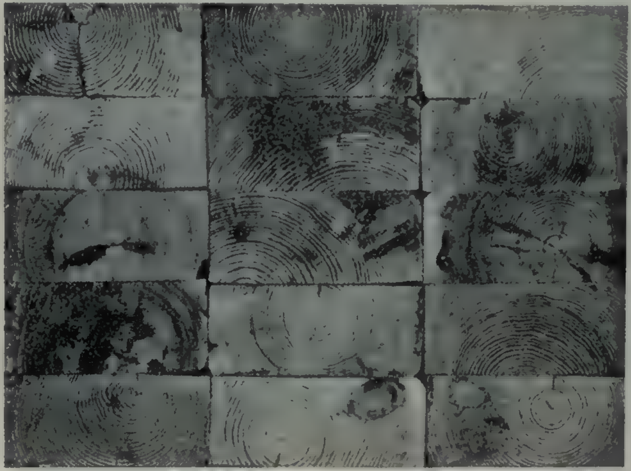
The first manifestations of rot were noticed about two years after the completion of the building in the sagging of floors, necessitating the shimming up of certain machines. An increase in the deflection in certain parts of the building was noticed, and a careful examination was instituted. It was found that a great many of the beams showed evidences of failures. It was considered wise to put in temporary posts here and there in order to reinforce the beams, and some of these were installed at once. In all, about three hundred and thirty temporary wooden posts were required within the ensuing twelve months, and the subsequent reconstruction of the building showed these temporary columns to have been essential to the safety of the structure while in use. Indeed, had it not been for the peculiar continuity and pliability of the mill construction floors, it is quite possible that accidents might have occurred even with this large number of temporary posts. The complete framework of the mill was removed and replaced with other material. During reconstruction careful notes were taken by inspectors, who were continuously on the work day and night.

Various degrees of deterioration were found; all the way from a trace of the fungus mycelium to what might be termed complete disintegration of the member. A great many of the beams were decayed so far that they fell into pieces in the process of being removed. Some were rotten to the core, and so much affected that with a crowbar or peavy one could readily break the beam into small pieces. It is doubtful if five per cent. of the whole number of timbers in the building were free from infection at the time of reconstruction.

The mill construction floors over the beams were affected also to a slight extent, but the results were not sufficiently serious to prevent them from performing their duty, and they were not removed. It is evident that in this case the resistance of the spruce floors to the attack of the fungi present was greater than that of the pine beams and columns, and the reason for this has been investigated. It is possible that the balance point of spruce with regard to relative humidity is different from that of yellow pine. When the shipment of yellow pine was delivered the remark was made by those handling it that it was as fine a shipment in appearance as any they had seen. After the completion of the mill any engineer or architect walking through the building undoubtedly would have pronounced it an eminently fine structure; yet within three years the entire framework of this building required renewal.

As a result of our study the conclusion was reached that the timber must have been affected prior to being placed in the structure. The use to which the building was put did not have anything to do with the ultimate result. Other mills have the same form of construction, and being operated in the same way have been in service for decades.

In discussing the timber specifications with dealers and others there appeared to be a difference of opinion as to the exact characteristics of the lumber which should have been supplied. This discussion led to a special study being made of the re-grading of yellow pine lumber. There are two main considerations in drawing up a specification for timber: one is durability, and the other structural strength. A piece of timber may have the necessary structural strength and have very little durability. In drawing up specifications where durability is of prime importance it is necessary, therefore, to choose between having high-grade timber and paying for the treatment of an inferior quality of stock. Where structural strength is of prime importance the choice lies between high-grade timber of a certain size and a large quantity of timber of a lower grading.



Part of 750 8" x 18" beams removed from a new factory in Montreal, after only three years' service. Rendered unsafe by decay.

The ordinary gradings in use up to a year or so ago apparently did not take into consideration all the factors necessary for durability and strength. The gradings for yellow pine were designed, seemingly, to meet the requirements of the lumber dealers. During the last year, two or three specifications have appeared which indicate that the requirements of the user as to durability and strength can be met.

Our researches convinced us of the necessity for describing timbers on a different basis from that formerly in use. We found what appeared to be a somewhat definite relation between certain of the physical characteristics of the beams and columns in this mill with regard to resistance to decay. The timber varied from very coarse-grained, having as few as three growth rings to a lineal inch measured along the radius of the section, to fine-grained beams having as many as twenty rings to the inch. The finer grained beams generally showed a higher resistance to decay than the coarse-grained, but this was not so universally. In some cases the fine-grained beams had a comparatively small percentage of dark summer wood, and these were more affected than a highly resinous, coarser-grained piece. Sapwood was found to be very susceptible to rot, but on the other hand heart wood was not entirely immune. Summing up all of the data we were able to collect, we concluded that the rosin content has a great deal to do with the resisting power of yellow pine. Generally speaking, those sticks which were dense and showed evidences of considerable rosin were much more resistant to the fungus attack than the lighter wood, even if fine-grained.

Oak columns and white pine floor beams removed from an entire floor of a factory in Ontario and replaced by steel after twenty-five years' service. Infection was introduced recently in new lumber used for a basement floor.

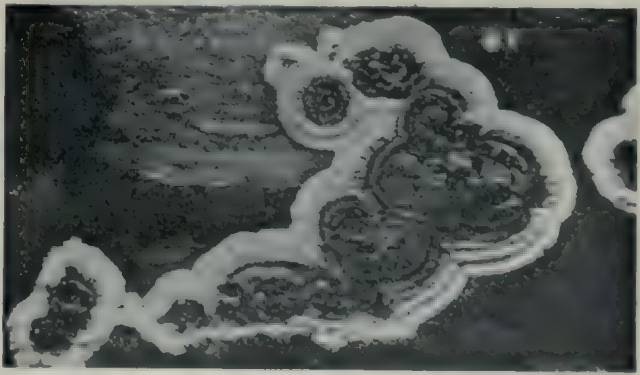
Dr. Carrie Derick, of McGill University, dealt fully with the botanical and biological sides of the question, explaining the structure of the woods, the various forms of fungi, and how the fungi affected different kinds of timber. Miss Derick also explained the methods by which the fungi spread, and the liking of certain species for various food materials. Good lumber used under proper conditions was an excellent building material, but it was perfectly useless to use poor lumber under circumstances where it was subjected to great strains.

Mr. F. J. Hoxie, Engineer and Special Inspector of the Associated Factory Mutual Fire Insurance Companies, Boston, remarked upon the stress some people laid upon ventilation in regard to dry rot. He pointed out, however, that it all depended upon the kind of ventilation, and that in some instances ventilation had encouraged, instead of retarded, the growth of fungi. Air taken from near the surface of warm, moist ground into a cool basement would prove worse than useless, as water would be precipitated from it on to the cooler woodwork, making it wetter instead of drier. Mr. Hoxie emphasized the importance of relative humidity in its relation to the growth of rot, and then alluded to the question of piling. He showed a picture of a Canadian lumber yard where the manufacturer used concrete bottoms for piling lumber; some lumbermen, he said, were under the impression that any old lumber was good enough for use in piling, and this was the cause of a considerable amount of infection. Other pictures illustrated tanks for treating lumber before piling, a method which had been proved to be effective. The percentage of rosin and the density were most important indices to the resisting power to decay in yellow pine. Mr. Hoxie concluded by pointing out the danger of using unsuitable lumber in mill construction.

Dr. J. S. Bates, Superintendent of the Forest Products Laboratories of Canada, stated that the laboratories had recently undertaken a general investigation of Nova Scotia mine timber. They had received from mine owners shipments of timber with a view to determine the relative strength of the various species; specimens of black and red spruce and balsam fir were obtained. When they started to make the tests it was found that the timber was infected with fungi, which of course affected the strength of the timber; the results showed that only forty per cent. of the 288 sticks were sound. Some mine owners wondered why the timber rotted so quickly; the investigation showed that some of the timber was rotting before it was put into the mines. As the result of the tests, it was found that the strength of the timber had decreased from 15 per cent. to 30 per cent., even with very little external sign of rot. With regard to the species, there was little difference so far as the deterioration was concerned. Enquiries elicited the fact that some of the pit props were not properly stored in the yards, and that they had absorbed a large quantity of moisture; there was also a considerable amount of rotten wood in the storage yard, which afforded excellent food for the fungi. Dr. Bates announced that the Department were undertaking experiments to determine the relation between moisture in lumber and the pressure of humidity in the surrounding air.

Mr. J. A. Jamieson referred to decay in timbers used in building grain elevators. His experience was that wood cut and placed in buildings in a very damp condition decayed rapidly; while in one case wood left to dry for twelve months was in an almost perfect condition after having been in use for twenty-five years. He asked how it was that in some instances the decay was found in the heart of the timber while the outside was sound?

Miss Derick replied that some trees were infected by reason of the wounds made through the branches being broken, allowing fungi to enter the heart, and still other timber was infected after it was cut, since in some species heartwood is more susceptible than the outer portions of the tree.



Coniophora, with fruit, on a beam removed from a cotton factory. Scale one-third natural size.

Dr. Porter, of McGill University, suggested that dry rot had increased of late years. He thought that this was due in part to the fact that years ago portable mills were more in use; now the establishment of large mills formed, as it were, fungus beds.

Mr. Hoxie was of opinion that the increase of rot cases was due to a certain extent to the kind of lumber which was now used. He pointed out that the supply of long leaf pine was not so reliable as it was in the past, and that loblolly, which formerly was rejected, was now being used in increasing quantities.

Dr. S. Kirsch also remarked that in Northern Quebec they formerly cut the best qualities of pine, but now the mills were shipping inferior grades. It was much more difficult to get good pine, and the shipping distances were greater.

Mr. John Kennedy, in moving a vote of thanks to the speakers, asked, "How shall we get good timber? We have to keep lumber in damp and hot places, and it is difficult to see a remedy." He hoped the investigations would result in a remedy being found for dry rot.

Mr. Walter J. Francis (the chairman), in closing the meeting, declared that wood was an excellent building material; probably 90 to 95 per cent. of the structures in which lumber was employed were satisfactory. Dry rot was very insidious in its operation, and the object of the discussion was to interest engineers in the subject, which was of growing importance.

The question of timber treatment was left for another meeting.

Suggested Specifications

It is of interest to note that Mr. F. J. Hoxie has recommended the following specification for adoption by The Associated Factory Mutual Fire Insurance Companies.

In making contracts for beams, columns and plank to be used in "Slow Burning Construction," the following specifications are recommended:

Density. No part of the material shall have a density of less than 30 pounds per cubic foot when tested by boring smooth holes one inch in diameter and two inches deep in the ends of the stick, drying to constant weight at 212 deg. F. and weighing the borings and computing the density from the volume of the hole.

Rosin. None of the heartwood shall show less than four per cent. of rosin by weight when borings are taken with a one-inch bit with a hole two inches deep, dried to constant weight at 212 deg. F. and extracted with benzole, the extracted rosin evaporated until it is not soft or sticky when touched with the finger at 70 deg. F.

Heartwood. Heartwood shall show in all four faces of every stick, and sapwood shall not extend more than two inches from the corner at any place, measured perpendicularly to the corner across the face.

Growth Rings. For timber 6-in. x 8-in. or larger, there must show on the cross section between the third and fourth inch, measured radially from the heart centre or pith, not less than six annual rings of growth, a majority of which shall show at least one-third summerwood, which is the dark portion of the annual rings; but wide ringed material excluded by this rule will be acceptable, providing that in the majority of the annual rings the dark ring is hard and in width equal to or greater than the adjacent light colored ring.

For pieces in which the centre is not included, there must show on the cross section, an average of not less than six annual rings of growth, with not less than one-third summerwood. Timbers will be rejected in which there is no sharp contrast in color between the springwood and summerwood.

Defects. No timber with knots greater than one inch in diameter, or rot, or injurious shakes will be accepted.

Branding. Longleaf pine sold under this specification shall be branded with the letters "F. M.," the name of the lumber manufacturer, the location of the sawmill from which it comes, and the date of sawing, in letters at least one inch high.

Accurate Daily and Total Cost Sheets for the Paving Contractor

By C. B. Montgomery

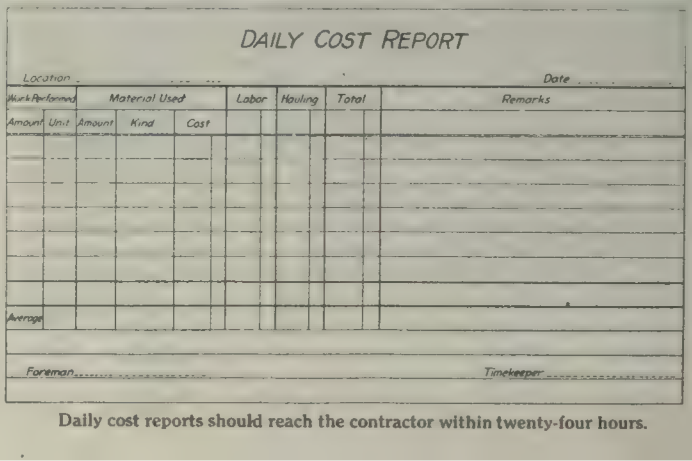
RELIABLE cost data serve two purposes for the paving contractor. First, immediate reports while the work is going on disclose leaks and inefficiencies that can be remedied with profit on the spot. Second, complete and accurately kept costs for one job furnish a basis for bidding rationally on the next one of a similar kind. This advantage is most pronounced in paving work, where similar conditions are met with again and again in the business of the same firm. It is also one which is too little realized, and seldom made use of by the average firm. A contractor will often merely ascertain the local prices of materials, estimate the labor requirements, add the conventional twenty per cent. for overhead, and then affix an item for profit determined largely by the amount of competition and the state of his exchequer.

Value of Daily Reports

Often a contractor will make or lose large sums without knowing where or why it occurred, and without giving a thought to what changes are needed under the same conditions on another job. Each day's work should be summarized, showing the labor and material costs and the contract value of the day's work done. This summary should be placed in the superintendent's or manager's hands within twenty-four hours. Thus leaks can be located at once and steps taken to remedy them. It is useless to censure a foreman for extravagances upon a job after it is completed, while, on the other hand, a timely pointer may often mean better results from the working force or a more economical use of materials.

The short form given herewith is a suitable means of achieving the object of these daily reports. A report such as this must be the foundation of any system, however elaborate. It shows all work performed each day, the total cost thereof and the average unit cost.

The long form fulfils the second object of the system. Upon this sheet is posted the information given on the short form, together with all other information regarding this particular job. Posting may be done daily, but weekly posting is recommended, as it greatly reduces the amount of clerical labor. This minimizes errors and thereby increases the value of



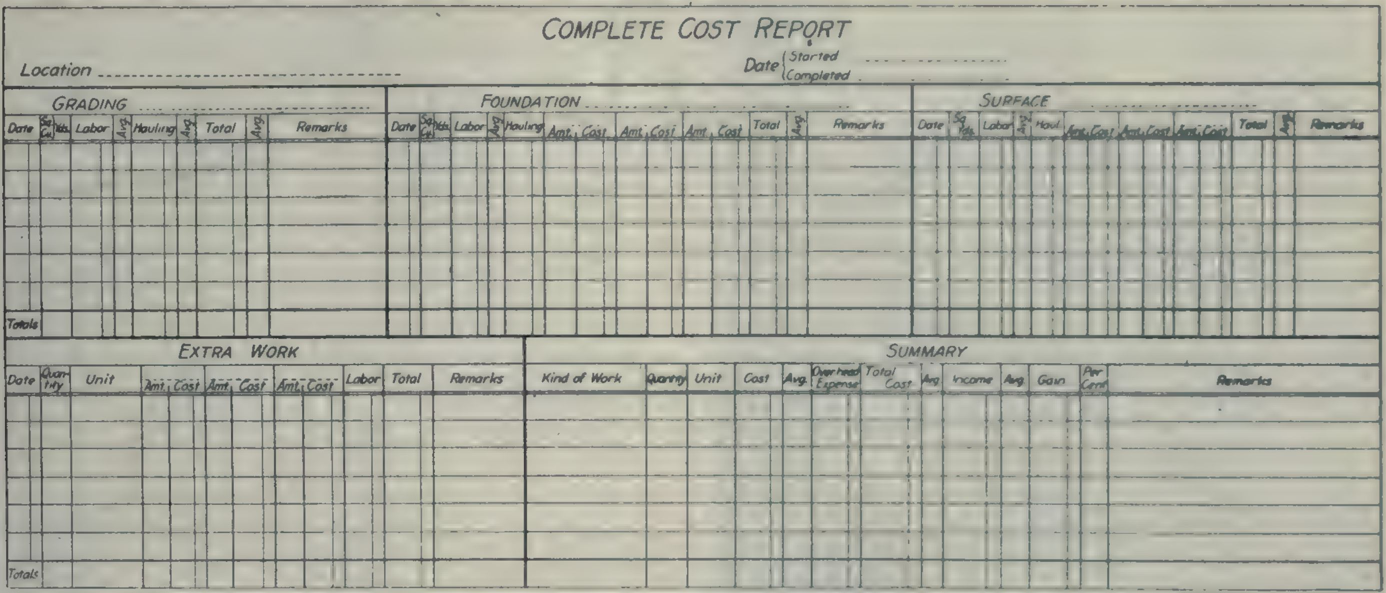
DAILY COST REPORT

Location .... Date ....

Work Performed		Material Used			Labor	Hauling	Total	Remarks
Amount	Unit	Amount	Kind	Cost				
Average								

Foreman .... Timekeeper ....

Daily cost reports should reach the contractor within twenty-four hours.



COMPLETE COST REPORT

Location ....

Date { Started .... / Completed ....

GRADING ....

Date	Sq. Cu. Yds.	Labor	Avg.	Hauling	Avg.	Total	Avg.	Remarks
Totals								

FOUNDATION ....

Date	Sq. Cu. Yds.	Labor	Avg.	Hauling	Amt. Cost	Amt. Cost	Amt. Cost	Total	Avg.	Remarks

SURFACE ....

Date	Sq. Yds.	Labor	Avg.	Haul	Amt. Cost	Amt. Cost	Amt. Cost	Total	Avg.	Remarks

EXTRA WORK

Date	Quantity	Unit	Amt. Cost	Amt. Cost	Amt. Cost	Labor	Total	Remarks
Totals								

SUMMARY

Kind of Work	Quantity	Unit	Cost	Avg.	Overhead Expense	Total Cost	Avg.	Income	Avg.	Gain	Per Cent	Remarks

Daily costs should be posted weekly on this form and checked with payrolls and invoices for material.

the cost sheet. At the end of each week or pay period the total labor amount posted should be checked with the payroll for that period. In a similar manner all materials should be checked with the invoices received.

For preserving these reports, the short form may be filed under the foreman's name, keeping the latest dates on top. The long forms may be conveniently bound in a loose-leaf binder, the names of the streets or jobs being in alphabetical order. When a job is completed the sheets can be transferred to a permanent file.

The subject of overhead expense is so complex and extensive that it will be impossible to discuss it more than briefly. It is of great importance, however, and should be included in any complete cost report. The common items constituting overhead are rent, light, heat, insurance, officers' salaries, tools and equipment, interest and discounts, office stationery, etc. The usual method of distributing overhead to the contracts performed is the inaccurate one of totalling the entire cost of a year's work, totalling the overhead for that year, and proportioning the latter evenly over the work. This method is not only loose, but requires waiting until the end of a year to get the complete cost. A modification of it, however, may be made to give much quicker and better results.

All overhead charges should be grouped under subheads, such as office expenses, which should include the clerical force, stationery, telephones, rent, etc.; tools; machinery, including steam shovels, concrete mixers, rollers, etc.; plant, counting such charges as rent, insurance, plant machinery, etc. (this item applying particularly to asphalt paving concerns who maintain expensive plants); general expenses, covering officers' salaries, interest and discounts, bad debts, etc.; and any other subheads which may be necessary. Of these subheads, all but plant and machinery should be handled alike and can therefore be lumped and treated as one. The total of these subheads should be distributed over the work for the year in this manner. The total labor cost of all work for a year should be taken as a basis for pro-rating the overhead. The amount or cost of materials used is not a factor in distributing any kind of overhead expense.

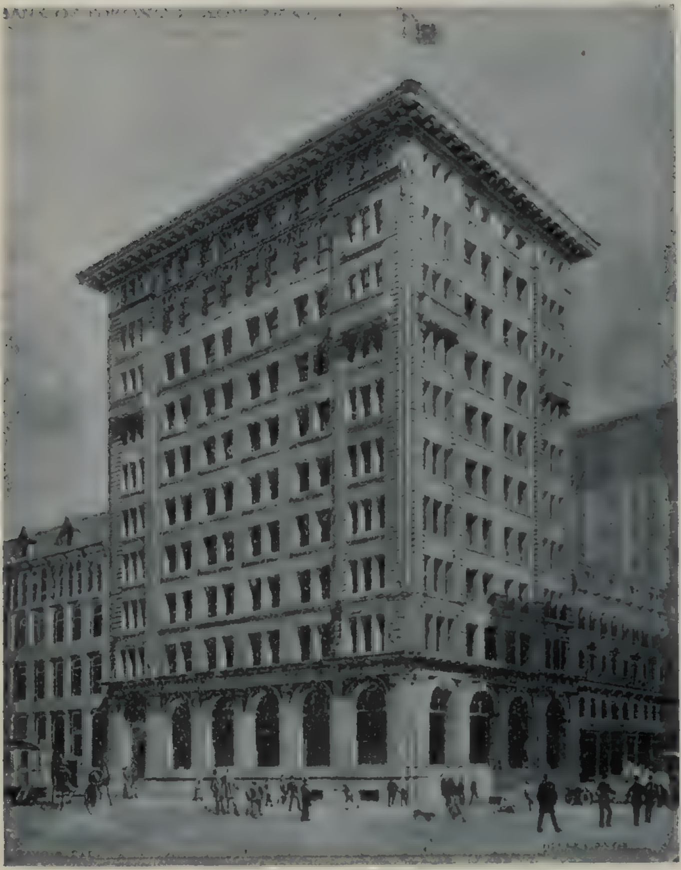
Expenses under the subhead plant are distributed only on the jobs which have received material from the plant. In the case of asphalt paving, the unit of production is the "box." The plant expenses for a year are divided by the number of boxes produced for that time and charged to the jobs where the material was delivered, in proportion to the quantities received by each. Machinery should, of course, be charged only to the work upon which it was used. The basis of division should be the number of days the machinery was in use.

It is desirable, as previously stated, to affix overhead charges immediately on completion of a piece of work, rather than to wait until the close of the fiscal year to determine the correct percentage. This should be done by using the percentages of the previous year. If, as is usually the case, conditions have changed, either by an increase or decrease in the volume of work done, or by an increase or decrease of overhead charges, the use of a previous year's percentage would result in a false showing which is not apparent until the close of a year's work. This difficulty is obviated by the method developed by the writer, of totalling and comparing the month's figures with the corresponding month of the previous year.

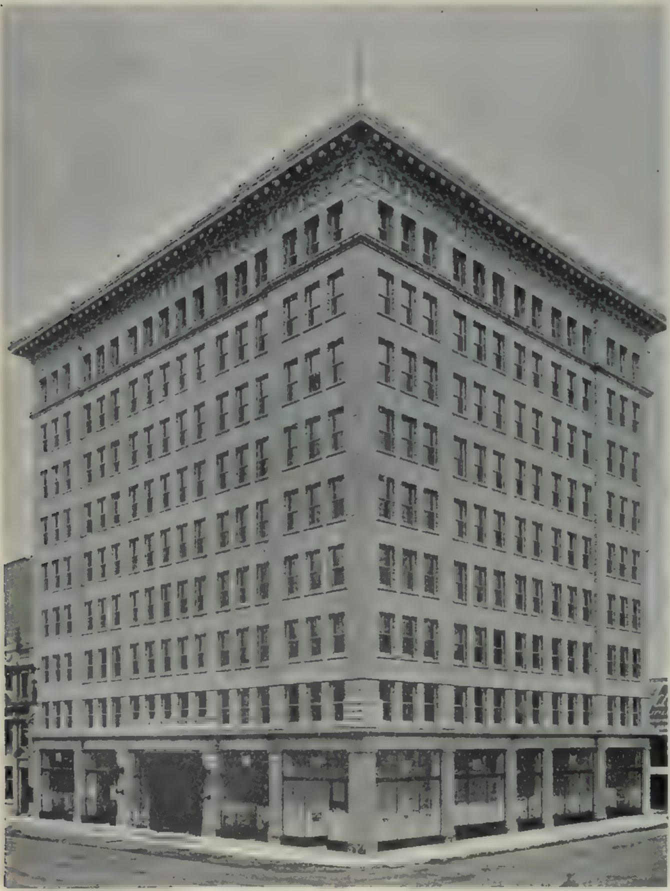
At the close of each month the figures for that month, both overhead and labor, are compared with the corresponding month of the previous year. The differences are added to or subtracted from the past year's totals. From these new totals a new percentage is obtained, to be used for that month's work.

For example, assume the total labor for the year 1914 to have been $25,600. The total overhead charges for the same year will be taken at $3,690, which means that the overhead charges for any given payroll should be 14.41 per cent. of the payroll. For the month of January, 1915, assume a labor cost of $6,440 as against $4,820 for January, 1914. This is an increase of $1,620, making a total for the year ending January 31, 1915, of $27,220. Assume also an overhead expense for January, 1915, of $1,800 as against $1,930 for January, 1914. This decrease of $130 gives a new overhead total estimated for the current year of $3,560. From these two new totals a new percentage of 13.08 is reached. Taking 13.08 per cent. of $6,440, we have the adjusted overhead charge for January, 1915, of $840.

Similarly, each month a new rate can be obtained which will change with changing conditions, and which will provide a more accurate figure than the method commonly in use.—Engineering Record.



The new Bank of Toronto at the corner of McGill and St. James Streets, Montreal.



The new McLeod Block at Edmonton, erected at a cost of $600,000.

The New Bank of Toronto at Montreal

ONE of the most important buildings erected in Montreal this year is the new Bank of Toronto, now being built at the corner of McGill and St. James Streets, by the Atlas Construction Company, from plans by Messrs. Hogle & Davis, Montreal. The Bank is on the site of the old premises and of some adjoining buildings on St. James Street. The area is 92 ft. x 64 ft., with an additional area of 40 ft. x 28 ft. at the rear. The building will consist of a basement and ten storeys.

The frame is of structural steel, with an exterior of polished granite base course, and above this terra-cotta. The floors will be of concrete, and the partitions will be fireproof. Each floor will have an area of approximately six thousand feet. Difficulties were encountered in the foundations, one-half of the ground being found unequal to the heavy load which it would have to bear. The Simplex Construction Company were called in, and placed one hundred and fifty standard Simplex piles. In our issue of November 18, 1914, we described in detail the methods by which these piles were placed.

The basement will contain the boilers, ventilating fans, and the Bank's vaults. The roofs of the latter will be of very heavy steel and reinforced concrete. The ground floor will be occupied by the Bank, the entrance being on St. James Street. On the east side of this floor will be three passenger elevators, supplied by the A. B. See Electric Elevator Company of Canada, Limited, Montreal. The Manager's and Assistant Manager's offices are placed facing the St. James Street elevation, while behind are the public hall and the various tellers', accountants', and clerks' offices. The remainder of the floors will consist of offices, finished in birch. The top floor is set aside for living rooms for the janitor, and a dining room for the staff. In the halls there will be marble dados four and a half feet high, while in the halls on the main floor the marble dados will be eight feet high.

A light-well will be situated in the rear portion of the building, the windows here being of metal. The following are the sub-contractors: steel frame, the Structural Steel Company, Limited, Montreal; heating, plumbing and ventilation, L. E. Moulton and Company, Limited, Montreal; electrical wiring, P. Lahee and Company, Montreal; granite, Stanstead Granite Quarries Company, Limited; terra-cotta, Atlantic Terra Cotta Company, New York; woodwork, Joseph Binnette, Montreal; hollow metal windows, A. B. Ormsby, Limited, Toronto; metal bank windows, H. Hope and Sons of Canada, Limited, Toronto; architectural iron work, Montreal Architectural Ironworks Company; glazing, Hobbs Manufacturing Company, Limited, Montreal; marble, Smith Marble and Construction Company, Limited, Montreal; roofing, Metal Shingle and Siding Company, Limited, Montreal.

A Pan-American Road Congress, under the joint auspices of the American Highway Association and the American Road Builders' Association, is to be held at San Francisco during the week beginning September 13. This date, which was decided on April 16 at a meeting of the joint committee representing the two associations, will enable engineers from the East to attend this Congress and also the International Engineering Congress which convenes the week following. Plans for the Congress are in charge of an executive committee, of which Hon. Chas. W. Gates, Governor of Vermont, is Chairman.

Method and Cost of Constructing Reinforced Concrete Drops on C.P.R. Irrigation Work[*]

THE Western Section of the Irrigation Block now being developed by the Department of Natural Resources of the Canadian Pacific Railway Company, has a large system of canals and ditches, the aggregate length of which is about 1,600 miles. There are a very large number of structures on the various canals and ditches. Some of the timber structures were built as early as 1905 and have been eight years in the ground. Most of these structures, especially the highway bridges and division gates, are good for a number of years yet, but some of the drops, of which there are a large number, are beginning to develop signs of weakness, and as they must be replaced without stopping the flow of water during the irrigation season, May 1 to October 1, the reconstruction must take place before or after the water season, or during that time by diverting the water around the structure by temporary works.

LABOR COST—DROP No. 2A—LANGDON DISTRICT.

Feature	Labor cost.	Unit cost.	Quantity and Unit		Remarks.
Moving camp	$ 68.00	......			About 16 miles
Setting up camp	19.55	......			About 24 men
Camp expenses	7.00	......			Dishes and repairs
Hauling supplies	159.30	......			Groceries, hay and oats
Excav. of by-pass	210.00	$ 0.139	1,507	cu. yds.	Clay loam
Excav. of old drop	1,250.00	0.636	1,967	cu. yds.	Hand work around old structure
Removal of old drop ...	126.80	2.338	54.243	M. ft. B. M.	Piling removed above grade
Building cement shed ...	8.96	8.070	1.112	M. ft. B. M.	Temporary structure
Building chute in by-pass	34.00	33.660	1.010	M. ft. B. M.	Drops water back into canal
Hauling lumber	46.60	1.987	23.438	M. ft. B. M.	Haul 2 miles
Hauling steel	4.10	0.031	129.96	cwt.	Haul 2 miles
Hauling cement	40.00	0.042	948.00	cwt.	Haul 2 miles
Hauling gravel	162.90	0.975	167	cu. yds.	Haul 2 miles
Hauling sand	72.00	1.060	68	cu. yds.	Haul 2 miles
Hauling sand and gravel .	88.60	2.685	33	cu. yds.	Haul 15 miles
Hauling mixer and pump	29.30	......			Haul 21 miles
Pumping water	13.10	......			
Building forms	591.00	0.100	5,929	sq. ft.	
Bending and placing steel and wire fabric	110.65	0.851	129.96	cwt.	
Mix. and placing concrete	336.10	1.680	200.00	cu. yds.	
Removal of forms	51.25	0.009	5,929	sq. ft.	
Backfilling by-pass	143.40	0.090	1,600	cu. yds.	
Backfilling drop	375.70	0.237	1,588	cu. yds.	
Removal of chute	6.88	6.812	1,010	M. ft. B. M.	
Repairs to bank	106.88	0.822	130	cu. yds.	
Riprap to bank	30.10	1.027	29.3	cu. yds.	Erosion by water from by-pass
Cleaning up, etc.	13.72	......			Extending 25 feet below drop
Total labor cost	$4,105.89		....	....	Includes team feed.

MATERIAL COST—DROP 2A—LANGDON DISTRICT

eature	Quantity	Cost	Freight	Total cost	Unit cost	Remarks
Reinforcing steel	11,921 lbs.	$229.72	$60.55	$290.27	$0.024	600 $\frac{5}{8}$-in. and 300 $\frac{1}{2}$-in. bars.
Wire fabric	1,075 s. f.	22.84	6.73	29.57	0.027	Clinton fabric
Cement	237 bbls.	482.86	45.75	528.61	2.230	Canada Cement Company.
Gravel	167 yds.	183.70	61.30	245.00	1.467	Calgary Sand & Gravel Co.
Sand	68 yds.	74.80	25.10	99.90	1.469	Calgary Sand & Gravel Co.
Lumber	23,438 ft. B. M.	323.94	54.80	290.13	12.380	Less $88.61 salvage value.
Rope repairs, etc.	....	44.35	.....	44.35	......	
Total material cost		$1,362.21	$254.23	$1,527.83	......	

Total labor cost, including team feed		$4,105.89
Total material cost		1,527.83
Depreciation on concrete mixer, pump, wagons, harness, horses, etc.	$302.44	
Depreciation on camp equipment	42.45	
		344.89
Overhead expense of superintendence, engineering, office work, accounting, etc.		938.00
		$6,916.61

The policy of the company has been to replace the large timber structures as they approached the end of their life with permanent concrete structures of approved design. The programme of betterments for 1913 included the replacement of the large timber holdup drop known as drop No. 2A in the Secondary "A" Canal, Langdon District, S. E. ¼ section 19-23-27. The new 10-ft. drop was designed to be built of reinforced concrete with a central pier and two openings that can be closed with stop plank 5 ft. 9 ins. long. The holdup feature of this drop is required to insure the delivery of water to "B" Distributary in Langdon district, which takes out 3 ft. above canal grade. The drop is designed to discharge 1,000 sec. ft. of water over the crest when the canal carries 8 ft. depth of water. Previous experience indicated the economy of diverting the water and building the drop during favorable weather, especially as rains and other conditions made it reasonably certain that a by-pass carrying 100 sec. ft. would satisfy the irrigation requirements. It was necessary, however, to carry 220 sec. ft. for a few days, which caused some additional bank erosion below the temporary drop. The construction crew was moved to the site July 17 to 19 and began the work of excavating the by-pass and building a diverting dam in the canal. The by-pass was completed July 29 and the work of tearing out the old timber drop commenced. The old structure was heavily built, having 2,200 lin. ft. of piling and 54,243 ft. B. M. of lumber incorporated in it. Certain timbers in the old drop proved to be pretty well decayed, particularly above the water line. The piling behind the breast wall was rotted and constituted the weakest spot in the structure.

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[*] By Robert S. Stockton, in Engineering and Contracting.

The excavation disclosed 4 ft. of soil underlaid by a compact boulder clay which proved to be quite impervious, and after the footings and lower concrete floor were in place, there was no pumping required.

The nearest gravel pit was about 15 miles distant and 42 cu. yds. of unscreened material was hauled and used. The pit contains good sand but poor gravel, and when the cost of screening was added and quality considered, it was thought best to ship the larger part of the sand and gravel to Bennett Siding, about two miles from the work. The gravel received from the Calgary Sand & Gravel Company, however, had some oversize that was picked out by hand. The steel shipped to Bennett Siding was mixed up with steel for Strathmore, which necessitated a team haul to straighten out.

A carload of lumber was delivered at Bennett Siding for building the forms, chute, and cement shed, and 1,421 F.B.M. was hauled from Dalroy Watermaster's Headquarters. The carpenters started building forms on August 6 and the cut-off walls were poured on August 27. The last concrete was put in on September 20.

The general mixture was intended to be 1 sack of cement to 2½ cu. ft. of sand and 5 cu. ft. of gravel. For thin walls and copings a mixture of 1-2½-4 was used, and for the lip of the drop 2-2½-5. Since 948 sacks of cement were used, the average was 4.74 sacks per cubic yard of concrete. The concrete was mixed wet enough to spade, and was spaded so as to require little patching when the forms were removed. The concrete appears to be of excellent quality. The concrete was mixed with a No. 1 Smith Mixer, with steam engine, boiler and side loader mounted on steel trucks.

All labor was paid at prevailing rates, stated at so much per day of 10 hours. Every rate is stated in full and so carried in the time books with board deduction of $5.50 per week. The cost of team feed is taken at 90 cts. per day per team and pro-rated to all work on which team time is charged.

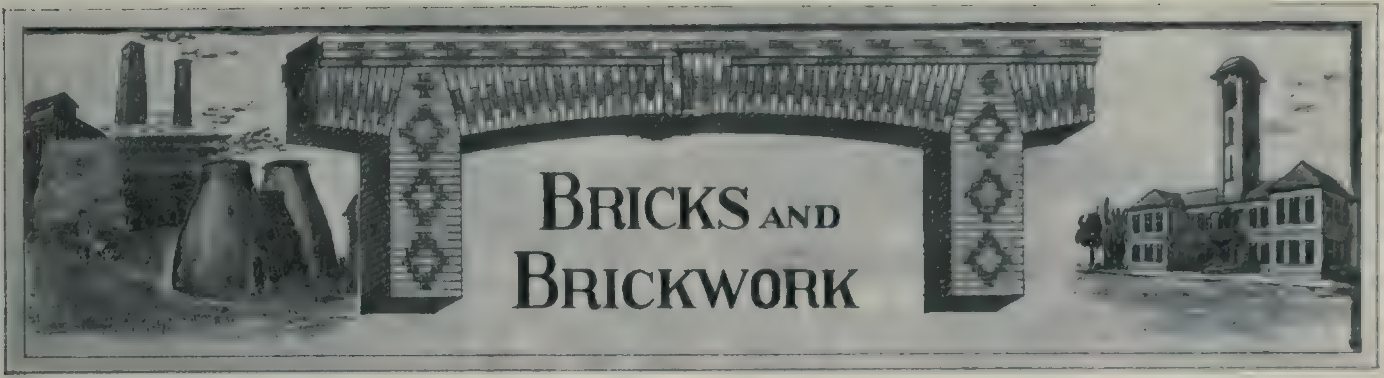
The wages of foreman, barn boss, and for Sunday time of teamsters were pro-rated to all labor items. Two rates of wages were paid, as it had been necessary to make a raise at harvest time to hold the men; even at the increased rate, considerable trouble was experienced, as farmers were then paying about $2.50 per day and board. The wages paid were as follows: laborers at $2.50 to $2.75 a day of 10 hours; teamsters at $2.10 to $2.35 a day of 10 hours, and including Sundays; carpenters at $3.50, $4 and $5 a day, and foreman at $120 a month. The foreman, Jack McMullen, ran the mixer when necessary. The work was directed by R. B. Stevens (Watermaster), and Mr. G. H. Patrick (Canal Superintendent), who reported to the Superintendent of Operation and Maintenance for the Western Section. The plans were furnished by the Chief Engineer, who is in general charge of operation, maintenance and construction for all the irrigation projects being developed by the Canadian Pacific Railway Company.

Summary of Feature Costs—Drop No. 2A—Langdon District, 1913.

Camp and supplies	$ 311.92	$ 1.560
Excavation and backfilling	2,085.98	10.430
Preparatory work	219.04	1.095
Hauling materials	414.20	2.071
Building forms	591.00	2.955
Bending and placing steel	110.65	0.554
Mixing and placing concrete	336.10	1.681
Removal of forms	51.25	0.257
Steel and wire fabric	319.84	1.595
Cement	528.61	2.643
Gravel and sand	344.90	1.725
Lumber	290.13	1.451
Riprap below drop	30.10	0.151
Depreciation	344.89	1.725
Overhead expense	938.00	4.690
	$6,916.61	$34.583
Camp and supplies and preparatory work	$ 530.96	$ 2.655
Excavation and backfilling	2,085.98	10.430
Concrete work	2,986.68	14.932
Riprap below drop	30.10	0.151
Depreciation	344.89	1.725
Overhead expense	938.00	4.690
	$6,916.61	$34.583

Electric motor omnibuses are being run by the city of York, England. The vehicle seats 22 passengers and weighs, with the storage battery, about 8,000 lbs. The battery used comprises 64 Edison cells, is placed under the seats, and has a capacity of 300-amp-hrs. at 72 volts. The omnibus can run at speeds from ten to twelve miles an hour and can make forty to forty-five miles before recharging. One advantage of the electric omnibus is that it requires so little attention from the driver that he is able to act as conductor as well as motorman. The entrance door is at the front, beside the driver's seat, and by running without a conductor the operating cost is greatly reduced.

The use of cement as an anti-sand blast is one deserving the attention of railway engineers. When locomotives stand under steel bridges or viaducts, the blast from the smoke shaft throws out gases and numerous small particles of ashes and coal, causing serious injury in course of time. In such cases cement has been successfully used, and now it is common practice on railways to cover the bottoms of bridges with reinforced concrete or cement mortar, which has been found to resist the attack of gases and also the blast of particles coming from the locomotives.



Review and Forecast of the Progress of the Burned Clay Industry in Eastern Canada

By Joseph Keele

THE present spell of growth and progress in Canada, beginning about ten years ago, found the native clayworking industry inadequate to supply the demand for building material. Consequently, such substitutes as concrete construction, sand-lime and cement brick, were largely used and a good deal of face-brick and fireproofing were imported from the United States. During the last three or four years several large plants have been erected in the vicinity of Toronto and Montreal for the manufacture of ordinary building brick. The output of these plants is now so large that there is no longer an excuse to use substitutes for brick, either on the score of price, quality, or promptness of delivery.

As competition in this field is bound to be keen, the future existence of the individual industries of this class will depend on their ability to produce the largest percentage of first quality brick per kiln, with the lowest cost of fuel and labor.

The recent great development of the industry in the area between Toronto and Hamilton was due to two conditions. The district contains an abundance of the best raw materials in Canada for the manufacture of rough clay products, and the two cities and neighboring towns offer a large market for the wares produced from them. The raw material used includes plastic shales from two formations—the Queenston and Lorraine, which are better known to clayworkers by their former names, Medina and Hudson River.

The soft, stoneless clays, of recent origin, are also more extensive in these localities than anywhere else in Ontario, except possibly in the clay belt of the northern portion of the province.

The Lorraine shale and stoneless brick clays of recent origin occur abundantly within easy reach of the city of Montreal, and these have been utilized freely in recent years in building up that city and its suburbs.

The city of Quebec is supplied with similar materials, conveniently situated. The first plant for the manufacture of shale brick was established near this city a few years ago. The products of this plant have been so satisfactory in every respect that a bright future is assured for it.

The city of Ottawa was dependent, until recently, upon the common brick made for surface clays in its vicinity. A few years ago an extensive plant was erected at Russel (about twenty miles distant) which utilized the Medina shale outcropping in that neighborhood. The greater part of the output goes to Ottawa. The Lorraine shales outcrop is in a large area just east of the city limits awaiting future developments. It is not utilized at present.

The Maritime Provinces possess the raw materials suitable for the manufacture of a greater range of clay products than is found in any other portion of Eastern Canada, but the surface clays are almost the only portion of their resources that are utilized at present. The principal brickmaking centres are at St. John, Pugwash and Annapolis, these points being selected on account of the raw materials available, and the facilities for distribution, both by land and water. The large plants which have been erected recently in these localities use the stoneless surface clays for brickmaking, while the large plants erected in the provinces of Ontario and Quebec use either of the two shale formations before mentioned.

Owing to their greater compressive strength, density and uniformity of size, the shale brick are preferred for underground work, such as trunk sewers, and for high structures carrying heavy floor loads. The future development of the brick industry, then, in the Maritime Provinces, will be in the utilization of the plastic shales with which they are bountifully supplied.

As far as the rough clay products industry in rural districts is concerned, there will be little or no change in the future as there has been in the past. The character of the product is fixed by tradition and usage, and by the raw material available at any given locality.

Any changes that are introduced will not affect the color and shape of the product, but will be manifested in improved or more economic method of production, such as the substitution of permanent down-draft kilns for the wasteful temporary scove or clamp kilns now in use.

One thing seems bound to happen, however, in this connection, and that is the extension of the practice of underground drainage for agricultural lands. This is done to a considerable extent already in Southern Ontario, but scarcely at all in Quebec or New Brunswick. No field drain-tile are produced in these two provinces, although they have extensive and widespread deposits of stoneless surface clays suitable for the purpose, as well as large regions of land which would be rendered much more productive by underdraining.

The development which is likely to occur, therefore, is the building of several small plants at various points, to which farmers from the surrounding districts can send their teams for a load of tile whenever required. This seems to be a more satisfactory plan than in having a few extensive tile works at certain centres, from which shipments would have to be made by railroad or barges to the rural districts.

The extensive belt of stoneless glacial clays in

Northern Ontario and Quebec contains material which is very suitable for the manufacturer of common-brick and drain-tile. These localities are situated too far from present markets to allow of their being worked for this purpose.

Owing to the abundance of wood in this region, brick and tile should be produced cheaply. A cheap freight rate to southern points might be secured by utilizing return empty coal cars from the divisional points on the Transcontinental Railway, which traverses the clay belt.

Face-Brick

The discussion so far has had reference to common brick made by either the soft-mud, or dry-pressed process. So much poor dry-pressed brick has been made in Eastern Canada in late years that I offer no apology for placing such in the common class. They can be bought at common prices also.

Some of the makers do keep up a high standard of excellence as regards density, finish and color for their dry-pressed product, and these always find a ready sale at prices considerably above that of the ordinary building brick.

The best architects, however, no longer regard the dry-pressed process as the high-water-mark in brick production. The smooth surfaces and tiresome uniformity of color do not lend themselves to effective treatment, especially for residence work. But it is probable that their use will be continued for business buildings.

Roughness in texture and variety of color are now regarded as most desirable qualities for face brick. The roughness is produced by a simple device attached to the brick machine, and variety of color is obtained by "flashing" during the burning process. In some localities in the United States kilns of this kind of brick are turned out which rival Turkish rugs in color and texture.

These brick are made from shales, the cost of production being practically the same as that of the ordinary wire-cut, but the profits are much greater.

A few of the leading brick plants in Ontario and Quebec have taken up the manufacture of rough-faced brick in a half-hearted manner as a recognition to a passing fad. These firms are essentially dry-pressed face brick makers; but it is significant to note that by overburning and flashing their dry-process wares they are catering to the desire for roughness of finish and diversity of color.

Of the twenty plants using either the Queenston or Lorraine shales in the triangular area included between Toronto, Hamilton and Credit Forks, twelve are wholly dry-press makers, while eight are wire-cut or mixed plants. Three of the latter make a small quantity of rough-texture face brick. One of these, the Ontario Government plant at Mimico, produces an article equally as good as most of the imported material. There appears to be an opportunity here for an enterprising brickmaker to produce a distinctive article which will bring him out of the common class into the region of greater profit.

One of the plants at Laprairie, near Montreal, uses the Lorraine shale to good effect in producing a rough-texture face brick for the Montreal market.

The Lorraine and Levis shales near the city of Quebec can be used to produce richer effects than those of the western shales.

The carboniferous shales in New Brunswick and Nova Scotia contain endless possibilities for this class of ware. That they have been unused up to the present denotes a singular lack of appreciation for the beauty of burned clay ware, and an unrivalled building material, in the cities of these provinces.

Fireproofing

Hollow blocks of various shapes, made of burned clay, are used largely as the fireproof clothing for steel frames in modern high structures—hence the trade name of fireproofing for this class of ware. The use of hollow blocks, however, is not confined to covering steel structures; they are now used extensively as a building material for the construction of exterior walls and partitions in factories, silos, dwellings and storehouses.

There are only four factories manufacturing this class of ware in Eastern Canada, and only one of these is devoted solely to this product. Three of these use surface clay, and one located in Toronto uses Lorraine shale.

The surface clay is not a very satisfactory material for fireproofing, the shales being better, as they produce a harder, stronger ware, which also stands transportation without undue loss from breakage.

The supply of home-made fireproofing is inadequate in quality and quantity.

Several brick plants already located on shales in any of the provinces might profitably take up this branch of the industry. Almost any of the plastic shales between Lake Huron and the Atlantic are suitable for the purpose. The use of hollow blocks made from burned clay is always increasing, and will continue to do so as long as building activity keeps up.

Paving Brick

Vitrifying clays or shales suitable for the manufacture of this class of clay products are comparatively rare in Eastern Canada. Nearly all of the paving brick used in Toronto and other localities in South-Western Ontario are imported from the United States. A small quantity of paving brick is made from the Lorraine shale at West Toronto. While these may be suitable for sidewalks or residential streets, their life is too short under the ordinary city traffic.

Certain shale deposits of the Levis and Sillery formations, which are probably suitable for the manufacture of paving brick, were discovered by the writer about two years ago. The Citadel Brick Company of Quebec is experimenting with these shales at present, so that paving brick may become one of its principal products in the future.

It is quite possible that paving blocks might be made from the Lorraine shales near Toronto or Montreal if a certain percentage of imported fire clay were added, in order to prolong the vitrification range of the shale and toughen the product. This is another opportunity for brickmakers in Ontario to get out of the common brick class.

The carboniferous formation in the coal mining districts of New Brunswick and Nova Scotia contain shale suitable for the manufacture of vitrified wares. No attempt has yet been made to develop this industry, the principal reason being that a market does not exist for them at that end of the country.

Sewer Pipe

Three plants are employed all the year round in the manufacturer of sewer pipe in Ontario. The raw material used is either the soft weathered top of the Queenston (Medina) shale or a transported clay washed from the same material, which occurs at Waterdown and vicinity, near Hamilton. This clay burns to a good strong red body, but does not take a very good salt glaze. It is the only material we know of in the province which is suitable for the purpose. These pipe are used extensively in Southern Ontario, notwithstanding the competition of the brightly glazed pipe made from fire clay or semi-redustrial wastes is rapidly gaining in importance, both fractory clay in Ohio or Missouri. The most extensive sewer pipe plant in the Dominion is situated at St. John, in the province of Quebec. The local clay is used, but a liberal stiffening of fire clay imported from New Jersey is added to it.

The shales already indicated as occurring in the vicinity of Levis might be used to advantage for this class of ware, as they take a good salt glaze, and are by far the most refractory shales found in the two provinces. With water transportation on the St. Lawrence and rail connection with all the principal centres, an important industry in vitrified wares might be established at Levis.

The carboniferous shales of the Maritime Provinces furnish the necessary raw materials for the manufacture of sewer pipe, as well as the coal for burning them. One plant has been established for several years at New Glasgow in Nova Scotia, which is now in a flourishing condition.

There is room for another sewer pipe plant at Moncton or in the Grand Lake coal area of New Brunswick. Ware like this is not like common brick, inasmuch as it can stand the freight charges for long haulage by rail.

Electrical Conduits

These are used for laying wires underground, their requisites being strength, straightness and impermeability. Conduits are generally made from fire clays or some semi-refractory clays or shales, finished with a salt glaze. None are produced in Canada, but hundreds of thousands of dollars' worth are imported annually from the United States. The telephone and telegraph companies prefer to go to the additional expense of conduits because of the saving in cost of maintenance and the superior service they give.

The Maritime Provinces are the only place where raw materials for this purpose are available. There is now a sufficient market in Canada to keep a large plant running on conduits alone, or it might be combined with the manufacture of sewer pipe and silo blocks.

Architectural Terra-Cotta

None of this material is produced in Canada, but it is now used extensively in all of our cities. It is generally made with a fire-clay or a buff burning semi-refractory clay, the finished ware being coated with a glaze or enamel, either white or tinted in color, or mottled to imitate granite. An industry of this kind requires a large staff of skilled workmen, for whom employment must be found all the year round.

Now that the Canadian market for architectural terra-cotta is large, a plant situated, for instance, on the Welland Canal, where fire-clay and coal could be brought by barge, ought to succeed.

The manufacture of enamelled brick and decorative tile for indoor work could be combined with the terra-cotta, as the same body and enamels could be used for all. The manufacture of red and buff terra-cotta, without a glaze, was carried on at the Don Valley Works in Toronto some years ago, but it was discontinued.

This industry might be revived again to advantage. Cornice, string courses and panels of this material could be combined with brickwork and be made very effective in many classes of buildings.

The Lorraine shales, the weathered top of the Queenston shales and certain of the surface clays can be used for this purpose.

Roofing Tile

The manufacture of roofing tile is not carried on in any part of Canada on a commercial scale. A few clayworkers in Eastern Canada have made tile for roofing houses in the vicinity of their plants, but none of them care to undertake making them for sale. The manufacture of roofing tile at the Ontario Government plant at Mimico has passed the experimental stage. They are now producing red tiles from the Lorraine shale which is as good in color and body as any of the imported tile. These tile are for the new Asylum Buildings at Whitby and are of the Spanish or "S" type. A large quantity of roofing tile is imported annually into this country for use on the best class of buildings. The shales in Ontario or the Maritime Provinces will supply the raw material, but a considerable amount of skill is required to make them.

Fuel

Fuel is one of the most important items to be considered in the future of the clayworking industry in Canada. Not so many years ago, wood was the only fuel used for burning. It was plentiful and cheap, and no very high temperatures were required for the class of clay wares then being made. Wood is increasing in price, and harder to obtain in large quantities. Higher temperatures with longer sustained fires are required for the better class of clay wares, and more coal than wood is now used in the clayworking industry in this country.

No coal occurs in either Ontario or Quebec, and very little in New Brunswick. Nova Scotia coal is shipped as far as Montreal. Very little of it comes further west. Most of the coal used in Ontario comes from Pennsylvania.

There is great waste of coal in the clay industry, due to defective or poorly built kilns, badly constructed furnaces giving imperfect combustion, careless firing and other causes. The use of producer gas or a perfect combustion furnace are two methods proposed by the brickworks' engineer for the elimination of waste in fuel.

A discussion of the various devices in kilns and furnaces is beyond the scope of this paper, but it has been demonstrated beyond question in a few plants that an immense saving of fuel can be effected and the smoke nuisance almost eliminated.

Refractory Goods

Clays suitable for the manufacture of refractory or even semi-refractory wares, practically do not occur in the provinces of Ontario and Quebec, as far as we know at present.

Fire clay is known to exist at one point in Ontario, but it is situated too far from transportation to be of economic value. This occurrence is situated on the Missinabi River, about forty miles north of Cochrane, a point on the National Transcontinental Railway. The deposit consists of white, pink and yellow plastic clays, the white clay, only, being a fire clay. Borings made on the deposit show at least 25 feet in thickness over a considerable area, 15 feet of which is white clay.

A four-foot bed of semi-refractory clay, softening at a temperature of about 1,600 deg. C., is found underlying the coal seam in eastern portions of the Grand Lake coal area of New Brunswick.

Plastic fire clays occur at three localities in Nova Scotia—at Shubenacadie, Inverness and Middle Musquodoboit. There is no railroad connection near the latter deposit. A large body of plastic felsite, which in this instance is a refractory rock but not plastic, occurs at Coxheath near Sydney. When this material is crushed and mixed with enough plastic fire clay to make it workable, an excellent quality of fire brick can be produced. No fire brick is made from the native refractory clays in the Maritime Provinces, one of the principal reasons for this being that the Scotch fire brick can be delivered from steamships at a very reasonable rate.

Stove linings and special shapes of fire-clay goods are made at St. John and Montreal in the province of Quebec. The fire clays for this purpose are imported from the State of New Jersey.

Silica brick are made from crushed quartzite, to which is added about three per cent. of lime for bonding purposes. These brick are molded by hand, and burned in kilns at a very high temperature. The raw material for this class of refractory ware occurs in Canada, but the cost of fuel for burning is large.

Whiteware

This term is used here to include table-ware, sanitary and electrical porcelain, white floor and wall tile. The raw materials entering into the composition of all whiteware bodies are: (1) kaolin, which is generally known by the trade name of China clay; (2) ball clay; (3) feldspar; (4) flint.

A limited amount of China clay is produced in Quebec, at a point about forty miles North-West of Montreal. This is the only locality, so far as known, at which it occurs. No ball clay has so far been found in Canada. Canadian feldspar is mined north of Kingston, Ontario, and shipped to New York State for grinding. Flint is generally ground quartz in America. Most of it is produced in the State of Maine, where it is ground for use in potteries. A large amount of fire clay is also used in the pottery industry, for making saggers—which are practically fire-clay boxes for holding the ware while burning. Whiteware industries are often situated at points where none of the raw materials occur, except possibly the fire clay. Convenience of transportation, a cheap fuel, and a large supply of skilled labor are the essential features of a pottery centre.

No table ware is made in Canada. There are two plants at St. John, Quebec, which manufacture sanitary porcelain.

Electrical porcelain is now made in Hamilton, Ont., by the Canadian Porcelain Company. Their output is chiefly large insulators for power lines. The General Electric Company also manufacture a certain amount of their porcelain at Peterborough. A plant for the manufacture of white vitrified floor tile was built recently at Kingston.

Every particle of the raw material used in the above industries is imported from England and the United States. As the consumption increases these factories will be enlarged or probably other factories will be established at various points in the future.

Economic considerations are probably against the establishment of an industry for the manufacture of table ware in Canada. These articles will continue to be imported for a considerable time to come. The only difference will be that a larger proportion will come from England, France and the United States, which hitherto came from Germany and Austria.

The time is past when anything that looked like a brick could be sold at a profit. The future demands will be more exacting, so that those clayworking plants which do not strive after excellence in production or are located on poor material will have to drop out of the business.

The weak spot in the clayworking industry is the lack of technical knowledge on the part of the majority concerned in it. Many costly mistakes are made every year in various parts of the country, being due to poor location, wrong equipment, or defective raw material.

Considerable skill and experience are required to build a modern clayworking plant and start it into successful operation, but the tendency seems to be to use the cheapest advice, on the popular assumption that anyone can make brick or tile.

Clays contain more disagreeable surprises for unwary manufacturers than any other kind of raw material, and it is often possible to detect and provide against these troubles in the preliminary examination.

The raw materials used in whiteware industries are fixed, and to a certain extent, unvarying. It is possible to foretell very closely what kind of ware will be produced in practice.

The things to be considered in starting an industry of this kind are: (1) a market for the wares; (2) location of plant; (3) fuel supply; (4) conditions favorable to a permanent supply of skilled labor. These questions, of course, are dependent on the vital one—whether foreign competition can be met. In the manufacture of clay products for structural materials, where the raw material is of an infinite variety, no reasonable trouble or expense should be spared during the preliminary investigations of the proposed site.

The following figures, compiled by Mr. John McLeish, of the Bureau of Mineral Resources and Statistics of the Department of Mines, show a considerable annual increase in the output of clay products during the last three years:

Value of Production of Clay Products by Provinces

	1911	1912	1913
Nova Scotia	$ 274,249	$ 272,053	$ 332,272
New Brunswick	38,000	54,910	62,269
Quebec	1,341,467	1,680,460	1,606,816
Ontario	3,916,575	4,864,700	5,220,467
Total value for Eastern Canada	$5,570,291	$6,872,123	$7,221,824

Extent of Production and Consumption of Clay Products in the Dominion

Total value of clay products produced in Canada during 1913	$9,504,314
Total value of clay products imported into Canada during 1913	7,237,885

Owing to the depression in the building trade during the latter part of 1914, it is probable that some decrease will be shown in the production of rough clay products when the returns are compiled. The clay industry, however, does not suffer to the extent that many others do in time of general depression.—Brick and Clay Record.

In New York City it is proposed to erect a building to be known as the Pan-American Building. If the plans go through, the new structure will put all other sky-scrapers in the shade, as they call for a building over one thousand feet high. The cost is estimated at seventeen million dollars.

Specifications for Bituminous Road Binder

THE following specifications followed carefully, according to Municipal Engineering, Indianapolis, will ensure an excellent material for bituminous road construction:—

A bituminous road binder, in order to be eligible for use under these specifications for the construction of a bituminous surface, of the type herein called for, must comply in all respects with the following practical and established tests for the purpose hereinafter stated.

The bid of each contractor must specifically state the brand of bituminous road binder which he proposes to use. He must give the name, nature, and chemical analysis of the material to be used, and where and by whom produced. His bid must be accompanied with a sample of at least 1 lb. of it, properly marked and identified. Bids which do not comply with this requirement will be rejected as irregular.

Test 1: Ductility.—In order to demonstrate the cementitious or adhesive character of the bituminous road binder, such binder as used must have a ductility of not less than 50 cm. at 77 deg. Fah., according to the District of Columbia standard.

Test 2: Specific Gravity.—In order to demonstrate that the bituminous road binder is of an asphaltic and cementitious character, as distinguished from an oily and non-cementitious character, and to preserve the proper balance between its adhesive and cohesive qualities, the specific gravity shall be not less than 1.04 at 77 deg. Fah.

Test 3: Paraffin Scale.—In order to further demonstrate that the bituminous road binder is of an asphaltic and cementitious character, and to ensure against the excessive use of non-cementitious materials produced from oils having a paraffin base, the bituminous road binder must not contain more than one-half of 1 per cent. of paraffin scale, as determined by the Holde method.

Test 4: Penetration.—In order to demonstrate that the bituminous road binder proposed to be used is of the proper degree of consistency, it must, when tested for five seconds at 77 deg. Fah. with a No. 2 needle weighted with 100 grammes, have a penetration of at least 12 mm. and not more than 15 mm.

Test 5: Volatilization.—In order to demonstrate that the bituminous road binder is of a sufficient stability to ensure against loss of consistency and cementitiousness upon being subjected to working heat, it shall meet the following test:—When 50 grammes of the bituminous road binder are heated in a dish 2¼ in. in diameter for seven hours at 325 deg. Fah., the loss shall not exceed 3 per cent. and the penetration and ductility of the residue shall not be reduced more than 50 per cent. from its original consistency and ductility.

Test 6: Viscosity.—In order to demonstrate that the bituminous road binder is of the proper degree of viscosity and to demonstrate that such binder has a sufficiently low melting point to ensure its penetration to a sufficient depth when poured upon or over the cold stone (or to ensure its mixing properly and conveniently with the mineral aggregate), it shall have a float test of not more than five minutes at 150 deg. Fah., as determined by the float test apparatus manufactured by Howard and Morse, Brooklyn, N.Y.

Test 7: Purity of the Bituminous Road Binder.—In order to demonstrate the percentage of bitumen in the bituminous road binder, and in order to regulate the uniformity of this material, it shall be soluble to the extent of at least 95 per cent. in carbon disulphide.

Test 8: Flash Point.—In order to ensure safety of operation the bituminous road binder must show a flash point (New York State closed oil tester) of not less than 325 deg. Fah.

Test 9: Durability.—In order to demonstrate that the bituminous road binder is sufficiently stable and durable, it must not suffer a reduction in ductility of more than 10 per cent. from its original ductility after it has been incorporated in the paving mixture and extracted therefrom with purified carbon disulphide.

Test 10: Standard.—Any bituminous road binder to be eligible for use under these specifications must be in all respects equal in quality to the standard bituminous road binder produced from refined Bermudez Lake asphalt; but whether the binder used is produced from refined Bermudez Lake asphalt or otherwise, it shall not be considered as complying with these specifications unless it complies with each and all of the tests hereinabove specified.

By having the plans for the enlargement of the Montreal filtration plant drawn in Montreal, instead of in New York, the city will save $6,000 in duties. The data will be supplied by Messrs. Hering & Fuller, the New York engineers.

Now that Germany, France and Belgium are in all likelihood to remain in the background for some years as far as furnishing railway material is concerned, large orders are likely to be placed in Canada, as the worn-out stock on the Argentine railways will have to be replaced if the railways are to be maintained in a state of efficiency. The Argentine railways extend to 21,000 miles.

Personal Mention

J. A. Culverwell, a well-known hydraulic and electrical engineer, died recently in Toronto.

Mr. J. G. Cummings has been confirmed in his appointment of City Engineer of Cranbrook, B.C.

Messrs. Huot, Henderson & Wadsworth, architects, have removed from the New Birks Building to 427 Old Birks Building, Montreal.

Mr. V. W. Horwood, Provincial Architect, of Manitoba, left Winnipeg last week for Rochester, Minn., where he will undergo an operation.

Mr. J. E. Parker, Town Engineer, of Amherst, has taken up the reins of office again after rather a serious indisposition of two or three weeks.

Capt. G. E. Blake Begy, a well-known contractor of St. Catharines, Ont., is among the wounded reported in the recent casualty list from the front.

Mr. DeGaspe Beaubien, consulting engineer and a member of the Montreal Electrical Service Commission, has been elected Vice-President of the Canadian Club, Montreal.

Mr. C. W. Van Buren has been appointed General Master Car Builder by Mr. C. W. Woodhouse, Chief Mechanical Engineer of the C. P. R., in place of Mr. R. W. Burnett, who has resigned.

Mr. George Janin, Chief Municipal Engineer and City Surveyor of Montreal, who was largely instrumental in raising a new corps of engineers for service in Europe, has left for England on his way to the front.

Mr. William Murdoch, City Engineer, of St John, has returned to New Brunswick after an extended tour of western Canada, in the course of which he visited Toronto, Winnipeg, Calgary, Edmonton, and other cities.

Lieut. F. H. Hertzberg, Toronto, of the Second Field Company of Canadian Engineers, was among the wounded reported in the last casualty list. The company to which he belongs is commanded by Captain T. C. Irving, Jr.

Lieut.-Col. W. P. Anderson, C.M.G., Chief Engineer of the Department of Marine and Fisheries, Ottawa, has gone to British Columbia for a six weeks' inspection trip. He is accompanied by the Deputy Minister of his Department.

Lieut. Herbert N. Klotz, who was killed in the recent battle north of Ypres, hailed from Toronto, where he was formerly employed as chemist by the Gutta-Percha and Rubber Company. Mr. Klotz was a graduate of the School of Practical Science.

Major Edward C. Norsworthy, of the 13th Battalion, Montreal, who was killed during the fighting at Langemarck, was a director of the Canada Cement Company, while Major Robt. Harry Jamieson, who was wounded in the forearm during the same battle, is Vice-President of R. C. Jamieson & Company, paint, varnish, and dry color manufacturers, Montreal.

Mr. J. A. Shaw, who has been Electrical Engineer of the Eastern Lines of the C. P. R. since 1908, with offices in Montreal, has been appointed Electrical Engineer of the entire C. P. R. system. Mr. Shaw joined the C. P. R. in 1904 as Assistant Electrical Engineer of Motive Power at the Angus Shops. He was made Electrical Engineer of the Eastern Lines four year later.

Mr. Ralph Hewson, of the engineering staff of the Toronto Harbour Commission, has joined the C. P. R. Overseas Construction Corps, and has left for St. John, N.B. Before his departure he was presented with a wrist-watch, a fountain pen, and an army jack-knife by members of the Commission staff. He is a brother of Mr. E. G. Hewson, Resident Engineer of the G. T. R. at the Union Station, Toronto.

Mr. W. A. McLean, Chief Engineer of Highways for the Province of Ontario, has returned to his office in the Parliament Buildings, Toronto. This will be welcome news to a wide circle of his friends. Mr. McLean was seriously indisposed in his home for several weeks, and it was particularly unfortunate that he was unable to discharge his duties as President of the International Road Congress held recently in Toronto.

Mr. Frank S. Swales, architect for the Hotel Vancouver, and other important structures, has just returned to Vancouver from San Francisco, where he went to superintend the finishing touches on the C. P. R. building at the Panama-Pacific Exposition, which he designed. He says that the extent and nature of the Japanese exhibits at Jewel City indicate that the aggressive Orientals intend to make a strong bid for the trade formerly almost exclusively handled by Germany.

Mr. William I. Bishop has been nominated for the office of Second Vice-President of The American Society of Engineering Contractors. Mr. Bishop has had a broad experience in engineering construction, both as a civil engineer and as a contractor. A record of his past work includes water-power developments, railroad construction, subways, tunnels, sewers, deep foundations, factory and other buildings. At the present time Mr. Bishop is a member of the Quebec Streams Commission, which has under its charge the improvement of the rivers of the Province of Quebec.

Mr. Samuel Hill, President of the Pacific Highway Association, accompanied by Major Bowlby, formerly State Highway Engineer of Oregon, has been making a tour of the good roads of Vancouver Island. Interviewed at Victoria, B.C., he said that he hoped that 1915 would witness the completion of the road from Vancouver, B.C., to the Mexican border. The most important addition, which would be opened this summer, was the Columbia River highway, upon which section some of the best road work on the Pacific Coast had been carried out. Mr. Hall had something to say about the importance of good roads. Railways followed later, he said; and he expressed the opinion that British Columbia, Washington and Oregon would be peopled very thickly in a few years, owing to the fact that every form of vegetation was possible on the Pacific slope.

Mr. Joseph Race on the Chlorination of Water

Mr. Joseph Race, City Bacteriologist of Ottawa, gave an address on the chlorination of water before a recent meeting of the Society of Chemical Industry in Montreal. Mr. Race gave it as his opinion that a properly applied treatment with calcium hypochloride of such water as that of the Ottawa River was the most practical method of attaining a pure supply. He dealt with many phases of the question, asserting that efficient admixture of the compound was the secret of successful treatment of the water, since better results were obtained by this method with a smaller quantity of the chemical than by using more hypochloride without recourse to mechanical means of diffusing it. He gave figures as a result of tests made in Ottawa, showing that, without mechanical admixture, a purification of only 87.5 per cent. had been obtained, while the water was made 99.2 per cent. pure by means of the process now employed.

With regard to corrosion of hot water systems, the speaker believed that no appreciable difference was made by this treatment of the water, as such soft waters as that of the Ottawa River were naturally prone to injure heating plants. If more frequent complaints had been made of such corrosion since the chlorination system had been in use, Mr. Race believed this was due largely to the inferior quality of the galvanized pipes put on the market, for he had found that many samples of such galvanized pipes, though well coated with zinc on the outside, were deficient in the inside. Brass or copper pipes might be more economical in the long run.

Tests had proved that the chlorination of water, as now practised in Ottawa, had no injurious effect on vegetable life, though animals refused to drink the water in normal quantities when a certain amount of the chemical diffused in it was passed. Such excess, however, was not required.

Messrs. W. F. Stanley & Company, Limited, 286 High Holborn, London, England, have sent us particulars of a new form of trench periscope which should make a most acceptable present for any soldier at the front. The "Stanley" periscope is a thoroughly practical instrument, with a strong collapsible aluminium frame, with two spikes for fixing into the side of the trench. It is equipped with plate-glass mirrors, well protected by metal sheaths. The whole is contained in a strong waterproof canvas case. The price is $6.50. The close proximity of the opposing trenches makes it of vital importance that the men should be enabled to take observations without exposing themselves, and this can only be done effectively by the use of such an instrument.

Messrs. A. H. Winter Joyner, Limited, representatives of a number of leading electrical specialty companies, have removed their offices from 76 Bay Street to 100 Wellington Street West, Toronto.

Mainly Constructional

East and West From Coast to Coast

The Brown Hoisting Machinery Company has been registered at Montreal.

Messrs. T. Benard & Sons, general contractors, Montreal, have dissolved partnership.

The Government of New Brunswick has adopted legislation granting a bonus for the erection of wheat mills throughout the province.

The Georgia-Harris bridge at Vancouver has been completed, and it is expected that the structure will be open to traffic on May 24.

The Frid-Lewis Company, Limited, contractors, of Winnipeg, are reported by Bradstreets to be in liquidation, with Mr. C. H. Newton interim liquidator.

The Kirkfield Portland Cement Company, Limited, Toronto and Raven Lake, are reported by Bradstreets to be in liquidation, with Mr. G. T. Clarkson appointed Receiver.

The Alberta Legislature have passed a bill providing for a Government loan of two million dollars to the Central Canada Railway for the construction of the McLellan-Peace River Crossing line.

At Calgary, Alta., the Council are strongly in favor of proceeding with the erection of the Centre Street bridge this year, and they are making every effort to sell the bonds for the bridge, which total some $375,000.

At North Temiskaming, Que., the substructure for a large steel bridge, costing $100,000, is nearing completion. The structure is being erected by the Dominion Government, whose engineer on the work is Mr. M. V. Denis.

New Brunswick is expecting to have a large influx of United States tourists this summer, and as a result the building of hotels is receiving an impetus. It is of interest to learn that plans are being prepared for the erection of a large hotel at St. John, N.B.

The offices and factory of the Ideal Concrete Machinery Company, Limited, have been removed from London to Windsor, Ont. The new plant is built entirely of concrete blocks made from the company's machinery, and demonstrates the practical use of this material for factory construction.

It is interesting to hear that Messrs. Masson, Limited, dealers in contractors' supplies, Quebec City, are doing quite a good business. Their structural steel department is in the hands of Mr. E. D. Kellogg, M.E. Their latest contract, which is worth $25,000, is for the structural steel frame of the new St. Roche's Church, Quebec.

The fair-wage scale proposed by the Montreal civic controllers, to which the Builders' Exchange objected as being in some instances beyond the rates asked for by the trades unions, has been rejected by the City Council. The objection was that the scale was not equitable, and that it was higher than that agreed upon between the contractors and the trades unions.

The plans for Calgary's new armoury have been completed by Mr. Leo Dowler—and it may be mentioned that tenders are open until May 25. The building is to be of red brick, with stone trimmings. The main drill hall will be 100 feet wide and 200 feet long. The armoury is the first of an extensive Government programme, which includes the new Post Office, Federal Building, and Receiver General's Building.

At a banquet held last week by the newly-organized Builders' Exchange, Guelph, Ont., a provisional committee was organized, with Mr. J. Occomore as Chairman, Mr. W. P. Colwill, Secretary, and the following members: Messrs. G. E. B. Grinyer, W. Cowan, R. Williams, A. Reynolds, J. J. Mahoney, C. Butler, W. G. Howell, H. Occomore, W. W. P. Colwill, and J. Baetz. A number of interesting addresses were given during the course of the evening. Mr. George Gonder, of Toronto, Vice-President and Secretary of the Provincial Association, was one of the speakers.

The Federal Government has placed an order for 2,500,000 barrels of cement with the Canada Cement Company, this being the second largest order for cement placed on the continent. The largest order—that for the Panama Canal—totalled four million barrels, and this went to a United States company. The delivery of the cement under the contract awarded the Canada Cement Company is spread over four years, the material being required chiefly for the Welland Canal. Although the construction of the canal is being carried out by contractors, the cement is supplied by the Government.

The Shawinigan Electro-Metals Company, Limited, has been incorporated with a capital of $50,000. Shawinigan Water and Power interests are identified with the company, Mr. Howard Murray, Mr. W. A. Hart, and Mr. Julian C. Smith being incorporators. Dr. A. Stansfield, of McGill University, is also an incorporator. The purpose of the company for the present is to carry out further experiments at Shawinigan Falls for the reduction of metals by electricity. Dr. Stansfield has done a large amount of work already in this direction at McGill University. He is at present on a visit to Vancouver, B.C.

Although a great majority of the Montreal building permits are for small residences or alterations, there are a few important buildings either in course of erection or contemplated. The contracts for the civic library and the St. Denis Theatre have been let, and tenders were called recently for the Oratory of St. Joseph of Mount Royal, and for a college for the Christian Brothers, Laval des Rapides, P.Q. The latter is a large project, the estimated cost exceeding half a million dollars. Some buildings for which plans were drawn last year, and in certain instances contracts concluded, are still held up.

At Victoria, B.C., judgment has been given in the action brought against the city by the Westholme Lumber Company to recover $500,000 in connection with a contract for the construction of the Sooke Lake waterworks system. The decision is in favor of the city, and establishes the fact that the contractors, having other important works on their hands at the time, had not the finances or equipment to carry out the Sooke Lake contract efficiently. The judgment is given by Mr. Justice Murphy, whose findings, according to the local press, are contained in a volume of sixty-four pages, comprising some sixteen thousand words. The hearing lasted six weeks.

Immediate action by the Joint Commission that has been investigating the pollution of boundary waters is promised by Dr. J. W. S. McCullough (Provincial Officer of Health), who returned to Toronto last week from Buffalo, where he had been in consultation with the Commission's Engineer. Dr. McCullough intimates that Buffalo and Detroit will probably be the first two cities to benefit. It is expected that they will be advised by the Commission to proceed with the preparation of plans for sewage treatment that will put a stop to the dumping of polluted matter into the lakes and rivers. The intention is to have the necessary arrangements proceeded with in order to get a start upon construction by next spring. While in Buffalo, Dr. McCullough, having in mind Toronto's steps toward garbage incineration, visited the Buffalo incinerator plant. The Provincial Officer of Health strongly criticizes the method adopted of employing women to sort the garbage as it passes along the carriers to the incinerator.

Interesting and Thrilling Work on the Fraser River

Mr. J. P. Napier and Mr. J. McHugh gave interesting papers—illustrated by lantern views—at a recent meeting of the Vancouver Branch of the Canadian Society of Civil Engineers, presided over by Mr. G. R. G. Conway. The speakers told of the remedial works on the Fraser River carried out by the Dominion and Provincial Governments in order to protect and foster the salmon fishing industry of the province, which for a time was seriously threatened by the partial blockade of the canyon through railway construction operations. Mr. Napier, Assistant Engineer of the Provincial Public Works Department, dealt with the preliminary work which had been done by the province in 1913, and Mr. McHugh, Engineer to the Dominion Fisheries Department, discussed in detail the main scheme undertaken later by the Federal authorities. In describing the main scheme Mr. McHugh explained that the work was carried out in the face of the most adverse physical disadvantages. The place where the big slide occurred was near the narrowest part of the Fraser River Canyon, Hell's Gate, where water foams through a restricted passage with terrific velocity. The sides of the chasm are precipitous cliffs, naked walls of rock, affording no foothold for the workmen. How the operations were conducted formed an interesting story of scientific method, painstaking endeavor and courageous effort on the part of engineers and workers alike.

Indians from far and near gathered near Hell's Gate in anticipation of a rich harvest. From time immemorial the aborigines had looked upon the narrow portions of the canyon as a provision by a beneficent Providence for their welfare and subsistence. They made preparations for a wholesale slaughter of the millions of salmon trapped on their way to the spawning grounds.

The Fisheries Department, however, took a different view of the situation. Stringent regulations were passed and enforced to prevent the threatened big killing. While the tremendous masses of rock were being blasted away temporary steps to alleviate the congestion were taken. Thousands of fish were caught in nets and transferred up the cliffs in baskets and across the most turbulent section of the torrent, and released again.

A flume was then built to divert the salmon to the upper reaches. The building of this facility entailed great physical discomfort to the workmen, who had to be suspended by ropes over the sides of the precipitous chasm, and there—drenched by icy spray, and often beneath the swirling waters—pursue their activities.

The work, which was started on March 21, 1914, was completed on March 9, this year. In all 60,000 cubic yards of rock were taken out, 40,000 being removed from Hell's Gate. The operations cost $110,000.

Peculiar Legal Case Now in Progress at Vancouver

Details of a peculiar case are to hand from Vancouver, B.C., where the Frantz Construction Company and A. Clemes are suing each other for $40,000.

Mr. Clemes is the proprietor of the Regent Hotel, which was built for him by the Frantz Construction Company. For some time prior to June, 1914, Mr. Clemes had been away in South America, leaving his business affairs in the hands of Mr. James Young. It is claimed by the plaintiff that in January, 1914, Mr. Young, acting on behalf of Mr. Clemes, entered into a contract to erect another eight-storey hotel, similar to the Regent Hotel, on a piece of property owned by Mr. Clemes on Hastings Street. Several stores were on the property.

An elaborate agreement was drawn up providing for a payment of $121,000 for the work, of which $100,000 was to be raised by a mortgage at 8 per cent. Mr. Frantz was to endeavor to get a tenant for the hotel at a rent of $1,600 per month for the first year, $1,700 per month for the second and third years, $2,000 per month for the fourth, fifth, sixth and seventh years, $2,300 a year for the eighth and ninth years, and $2,400 a year for the tenth year.

Mr. Frantz said he secured a prospective tenant and started at work on the contract by ordering the tenants to leave the old stores, which he proceeded to tear down. While the wrecking was in progress Mr. Clemes returned from South America and repudiated the whole contract, ordering the work of destruction to cease. Claiming that Mr. Young had power to act as agent for Mr. Clemes, the Frantz Construction Company is claiming $41,354 damages for breach of the agreement.

In his defence Mr. Clemes denies that Mr. Young had any authority to enter into such a contract on his behalf. He says it cost him $27,400 to repair the damage done by the wreckers to his property, that he had to pay $4,000 compensation and that he lost $9,425 in rents. Accordingly he counterclaims for $39,645 damages.

Trade Inquiries

The Weekly Report of the Department of Trade and Commerce contains the following inquiries relating to Canadian trade. The names and addresses of the firms making these inquiries can be obtained by those specially interested in the respective commodities upon application to the Inquiries Branch, Department of Trade and Commerce, Ottawa:—

551. **Steel, iron, nails, wire.**—A firm in Paris is desirous of receiving offers from Canadian mills.

559. **Steel, iron bars, flats, square, round, etc.**—A French firm of dealers in metals is anxious to receive offers from Canadian mills.

543. **Sewer pipes.**—Canadian manufacturers of earthenware sewer pipes should communicate at once with a Newfoundland official.

527. **Building timber.**—An Australian firm seeks supplies of British Columbia fir, hemlock and other building timber

528. **Fibro-cement sheets.**—Inquiry is made by the London office of an Australian firm for names of Canadian manufacturers of fibro-cement sheets.

519. **Lumber for building purposes.**—Two French firms are anxious to receive quotations, etc., from Canadian mills and exporters.

Frank Law, a contractor who has carried out a considerable number of road improvement contracts throughout Ontario, was instantly killed on the Kingston Road, Toronto, last week, when his car ran into a ditch and turned turtle. The late Mr. Law was forty-five years old.

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A Ripe Example of Architectural Inefficiency

IN an article dealing with architectural inefficiency, published in our issue of January 20th last, we classified the members of the profession in three types, of which efficiency was represented by the figure of 17 per cent. In support of our arguments we referred to a number of legal decisions against architects—typical cases in which the profession had exhibited negligence and other unbusinesslike and inefficient traits.

Our article gave rise to considerable discussion. The Building News, of London (Eng.), treated the matter at some length in a leading editorial article, while Mr. R. M. Fripp, F.S.A., of Vancouver (President of the Architectural Institute of British Columbia), took up the cudgels on behalf of the profession in our issue of March 17. The case for the defence was presented in a very able manner by Mr. Fripp, but it collapses under the weight of the evidence of those who have had "unfortunate experiences" the possibility of which Mr. Fripp himself admitted.

In the way of a specific instance of an "unfortunate experience" it may be of interest to tell of what happened to a man who engaged a leading architectural firm to prepare plans for an hotel building, costing, complete in all departments, not more than $500,000. (Before it was actually completed and ready for occupation it cost $1,250,000!!) The owner had confidence in the standing of the firm, and at the outset he followed their recommendations implicitly—with the result that construction work was started before the complete plans and specifications were delivered and before bids were secured on the whole installation. The result was that he was at the mercy of these gentlemen, as the subsequent installation necessarily had to conform to the shell of the building. When the plans were submitted they were incomplete in every way. The most common details of hotel planning were omitted, and one of many blunders consisted of duplicating plumbing and water supply pipes for adjoining tiers of bathrooms. After endless trouble and worry the building had to be re-designed and reconstructed, resulting in extras of some $100,000.

In this case the owner attributed his "unfortunate experience" not so much to the wilful indifference of the architects as to their ignorance of the requirements of a modern hotel and their inability or unwillingness to learn them. Apparently the members of the firm were uninformed on some of the most elementary requirements of design and construction.

As a result of his experience the hotel man is of the opinion that the average architect is wholly unfit to be entrusted with the details of a large building project:—"He is bound by precedent to such an extent that he lacks receptivity; he is not in sympathy with new ideas or new designs; and he looks with hostility on any suggestion that may be a departure from the beaten path to which he has been accustomed."

There would appear to be much truth in the contention that the average architect who has been in business for a number of years and has got on fairly well in the way of accumulating money acquires an exaggerated idea of his ability and importance. This is true in Canada. The architectural profession in this country may be said to be in its infancy: it has yet to make its history. Albeit, some of the leading members of the profession are harder to see than a Cabinet Minister. Their time is reserved exclusively for clients. Within the sacred precincts of their office never has the foot of a supply traveller or other such inferior specimen of humanity yet trod. They imagine all sorts of highly exaggerated things about their professional status, and they attribute to themselves a combination of excellent qualities while possessing none of them. As for what they know, they are informed in every branch of building and contracting! Expert advice with them is quite superfluous. They claim to be able to design and erect any sort of a building, regardless of its technical character, and they will actually undertake it without seeking advice from specialists. Instances where this has been done and carried to a ludicrous extent are numerous.

Too often the architect is lacking in the most elementary knowledge, and it is only after the building operations are complete and expensive mistakes have been made that the owner or builder starts thinking about architectural inefficiency.

"Unfortunate experiences" with architects! How many times have we not heard of ridiculous mistakes in estimating the cost of new buildings? The architect is assumed to know something of prices and the ultimate cost of building construction, but we are in agreement with the gentleman whose experience we have cited above, that "one may take the average man of affairs and secure from him a more accurate estimate of costs than one can get from the average architect."

Much more might be said about "unfortunate experiences," but the other phases of the subject will provide food for later discussion, perhaps.

Advance Planning Cheapens Construction

COSTS can be cut by planning in the home office or the construction office the details usually left to workmen and foremen. In a paper presented recently before the Western Society of Engineers by Sanford E. Thompson and William O. Lichtner it is shown that one firm engaged in reinforced-concrete building work cut costs on form work alone by the use of these methods from 7¾ cents to 5½ cents per square foot. The methods outlined have been applied with equally striking results to several classes of construction.

According to this method, such planning includes not merely laying out the installation of heavy machinery, the successive moves of derricks, etc., but also planning the delivery of material and all the different moves to be made by individual gangs from the start to the finish of the job.

Sequence of Work Studied

First, the entire job, including all temporary as well as permanent structures, is studied from beginning to end, and detailed plans of everything to be made on that job are worked out. Next, the sequence of the job is planned from beginning to end, and every construction operation, down to the successive erections of temporary platforms, planned. Then a purchasing schedule of every item that will be used is made, and transferred to material slips showing what is needed, when it must be ordered, and to what spot on the work it must be delivered. A schedule is made showing the number of men and foremen of each trade required from start to finish to accomplish the work as it is laid out on the progress schedule. So far as possible (and the farther it is carried the better it pays) the amount of work to be done by each gang, and even each man, is reasonably laid out for each day, and cash bonuses are provided for exceeding the estimated day's work. Finally, the superintendent and the force at the job must see that materials arrive as called for on the schedule; that the proper number of men are provided; that work starts at each particular part of construction on the proper date; and that each foreman and man understands in advance exactly what he is to do and how he is to do it.

There rests with the superintendent and his force the task of training the foremen and workmen in the most efficient methods of going at their work. If the men's moves are planned in advance in this way, and the right materials and tools delivered to them at the proper place and time, and cash inducements offered them to develop their efficiency and exceed their schedule, the work will be in no danger of lagging behind the desired progress.

This plan, of course, requires that the designing force be in much closer touch with the construction force than is the case with most contracting firms. The planners, of whom the superintendent should be one, must be men with engineering knowledge, but also men who know construction work thoroughly and who are capable of laying out schedules without any of the absurdities so often found in such plans.

Made in Canada

THE "Made-in-Canada" idea is a curious anomaly, in that it combines the best and the worst business principle—the best in the idea of having Canadian goods occupy a position of pre-eminence by virtue of quality and value, and the worst in that of using the cloak of patriotism to cover the foisting of inferior goods at a higher price.

In theory there is much to commend the "Made-in-Canada" movement; in practice there is much to restrict it. If we are going to promote it successfully we must put reputation first and dollars last; we must make "Made in Canada" synonymous with "Made RIGHT in Canada."

Quite recently we heard of a large restaurant owner who wanted a couple of hundred bentwood chairs bearing the "Made-in-Canada" label. He had to pay the same price for the Canadian chair as for the Austrian chair, and he got a distinctly inferior article: he paid 25 or 30 per cent. for his "patriotism."

Not long since a well-known United States advertising journal conducted a careful inquiry into the wisdom of fostering the "Made-in-U.S.A." idea, and the expression of opinion contributed by the heads of some of the largest concerns in the United States was distinctly unfavorable. Perhaps the best sentiment is expressed by one of the contributors in the following extract: "Of course I am a believer in American goods; but an ounce of doing is worth a ton of preaching. When our manufacturers have produced things that are a little better than similar things produced elsewhere you may be sure that the people of this country will buy them."

Pre-eminence in competition is the only sure foundation of success. Essay to build up the business of the country under the protection of a high tariff wall, if you will; allow your manufacturers to combine and put up their prices, the while delivering inferior goods—and your whole structure will crumble and decay.

There is no use in our running wild on the "Made-in-Canada" slogan. Neither as manufacturers nor as consumers will it pay us to isolate ourselves from the outside world. The benefit would accrue only to the select few. Canada first and Canada last—but VALUE FOR VALUE, AND COMPETITION ALWAYS, if we are to remain a factor worth considering in the industrial world.

Self-Election

THE ablest leaders are self-chosen, comments Engineering and Contracting, editorially. This is true industrially as it is true politically. When the civil war began, many volunteer companies and regiments elected their own officers. The choice commonly fell upon the men who looked or talked the military part. However, a few months of actual service under gun fire effected radical changes. Then brave and resourceful men in the ranks proceeded to make themselves leaders. The iron soldier pushed the tin soldier aside. Every war repeats such history.

In politics we see much the same phenomenon, but there it is obscured by the fact that the real political leaders often remain hidden from the public eye. From the adviser who dominates a king to the ward boss who controls a city council, it is the self-chosen man who often rules. Unfortunately political rule of this sort is apt to be bad, because secret control is conducive to selfish and dishonest action.

In the industrial world, co-operative production, under chosen managers, has usually proved inefficient. The workmen who chose a manager of a co-operative factory either select a "good fellow" type of man or one who talks plausibly. In either case the chance of selecting wisely is not great.

In every walk of life the really capable leader nominates and elects himself. The soldier, by virtue of his own fighting force, seizes the epaulettes. The industrial worker, ignoring the opinions of his mates, sets up in business for himself—elects himself a sergeant in the industrial army. It is true that thousands thus self-elected fail to maintain their positions. Their courage or their self-esteem often exceeds their ability. But, none the less, by this process of self-election do the fittest business managers emerge from the crowd.

The training of engineers, coupled with their ethical codes forbidding self-advertising except in the mildest manner, has not been favorable to their pushing themselves into managerial positions. In spite of these handicaps, however, engineers, here and there, have decided that they were more fit to manage affairs than were the existing occupants of certain managerial positions. Accordingly, they have not waited to be "urged to run," but have set about making themselves executives. Thus it has come about that most of the "city managers" in the two dozen cities that have adopted the new form of government are engineers.

Only in a restricted sense it is true that "all things come to him who waits." All that a waiter commonly gets is tips—the pecuniary crumbs from the rich man's table. Much truer is it that all things come to him who nominates himself, and, ballot after ballot, casts a unanimous vote for his nominee.

Balance in Design

EQUAL disposition of mass about a centre or axis is due to a law having its origin in the demands of equilibrium. In architecture the rule applies rigidly to free-standing parts and components, such as columns. It cannot always, and need never, of necessity, apply to a whole composition. No doubt a peculiar dignity, not obtainable otherwise, attends the exactly-balanced facade in monumental buildings; but site, circumstances, and practical conditions often make it an impossibility for the designer to proceed on centre-and-wings principle. We have, then, to design irregular building masses with grace and beauty. Irregular architectural composition favours variation and novelty: that which at first sight seems an evil need not necessarily prove so. Looking back into architectural history, we see that irregular plans are by no means inconsistent with grandeur of effect. The departure from exact balance in Gothic buildings gave them one of their greatest charms.

In all styles the rule of exact symmetry in the part is closely followed. This assertion may seem inconsistent with fact, and would be so did we not here include all components that are wanting in exact equal-sidedness by reason of their breaking into other masses. Where a square plan breaks into a circular, the square and the circle are broken; but the spirit and intention in the square and in the circular plan is exact symmetry. When, therefore, we assert that in all great architectural styles the law of equal disposition of mass about a centre or plane is duly honoured, we include, for the reason stated, symmetrical components breaking into others. It is possible that those of expansive views, but small practical experience, in architectural design would regard part breaking into part, and leaving an irregular junction, as fatal to all beauty of effect. The architect will contend that such irregular junction, whereby something on asymmetric principles is produced by the union of two symmetrical objects, is not only without offence, but may originate great beauty and interest, and is quite an essential in the "picturesque." If we generally agree upon this, then something is gained of practical usefulness to the asymmetrical planner, and to all whose minds are greatly exercised with questions of "balance" whenever they are compelled to abandon the principle of centre-and-wings.

The stair-turret and the tower are largely evidenced in our old village churches. We have shown that both the turret and the tower are planned, in spirit, as objects of geometrical regularity and exact symmetry (so called). As carried out, an irregular, unbalanced mass is produced. To destroy symmetrical orderliness by breaking the one into the other seems, at first, a crude idea, likely to cause offence; but we have urged, and taken for granted the concurrence of the reader in our view, that no such offence is produced, but that, on the contrary, a resultant architectural mass of true beauty and interest is obtained.

Under certain conditions, an element or compound will crystallize in true "symmetry" as a cubical figure, a tetrahedron, or the like. Under other conditions the crystals cluster. The freeborn, regular, isolated crystal is an object of beauty; but no less beautiful or interesting is the group of associated crystals. Yet here, as with our turret and tower, and as in the case of all irregular junctions of divergent masses in building, broken and diverse—asymmetric—forms are produced; but so much of each crystal as exhibits itself is true to the crystal form, true to angle of crystallization, and possessed of symmetry. On the face of things, one might conclude that the irregular massing of crystals would destroy their beauty. All who carefully ponder this matter will admit, we think, that the resultant forms, lines, outlines, and masses are beautiful, often very beautiful indeed, and highly suggestive for the picturesque grouping of masses of building on the asymmetric system—that is, opposed to the centre-and-wings arrangement. We should consider this natural phenomenon, and endeavour to establish some general proposition respecting the breaking-in of part to part in architectural composition. On elevation, such masses may appear at times "lopsided"; but this effect of out-of-balance disappears in perspective.

The laws of exact symmetrical, or equal-sided, composition having become of none effect by our abandonment of the centre-and-wings principle, on account of site or questions of practical service, we no doubt are often tempted to endeavour to restore a quasi-balance by some suitable manipulation of the masses. We believe this anxiety to be born of a misapprehension. As we have suggested, that which in elevation strikes the eye as out-of-balance and wanting redress may not appear to have such defect in actual building. Rochester Castle has an asymmetrical addition. Fond of exact symmetry, this might not please on an elevation. It is doubtful if any, on pure aesthetic grounds, would desire to remove the addition; it might be more than suspected that its removal, while certainly leaving a symmetrical keep, would leave us with a grievance and regrets.

Once we have, either by choice or necessity, abandoned the centre-and-wing plan, we must, we assume, proceed on a different fundamental design principle. Asymmetrical or irregular composition must be adopted without compromise. There must be no weak leaning towards the rules of symmetry, and we should ascertain what will be the true effect of masses in execution before we amend apparent defect on elevation. Equal-side, centre-and-wing composition of a whole facade is one way; the other is totally different. It was, some time back, observed to us, on passing a block of office buildings, that it seemed that the tower "should have been bigger." The observation was not made by an architect; but, all the same, it was much to the point. A strictly "symmetrical" facade, with equal mass right and left, up to about roof-line, had on one side a weak, half-hearted turren—an excrescence just budding, one might say. The effect and impression was that the designer had hesitated to destroy the exact equal-sidedness. Had a bold tower been provided, the composition, from a mere tribute to pseudo, or distorted, symmetry, would have passed clear into true asymmetry.

In a very difficult subject, we have endeavoured to suggest two rules for guidance in irregular architectural composition, such as we find must necessarily pertain in the great majority of buildings: firstly, to maintain the great principle of mathematical equal-sidedness in the part, either actually, as in a column, or in spirit and intention, as in the circular turret breaking into the square tower; and, secondly, that when once the symmetrical whole facade is not possible, or not desired, the asymmetric principle should be consistently obserevd. If we believe in the former suggested rule, we shall not put pilasters with one left-hand volute on the right side of a facade, with a right-hand, single-voluted cap on the left wing. In irregular architectural composition we must needs be too urgently concerned in rendering each part beautiful to have time to waste in perpetrating these or other monstrosities. The offence is against the rule of studied "symmetry" in the part. The strongest argument for irregular architecture, and for dispersed ornamental device, is that each part of the composition may be so fashioned as to be interesting and graceful, irrespective of other parts. In unbalanced (in a sense) composition we need not distort the unit for the sake of some whole effect; and a beautiful building, surely, should be such that, as we pass along, every part, contributory on the whole, should appear an object of interest and beauty. Then architecture bears comparison with music. Our subconsciousness, or memory, holds the general air and progress of rhythm and melody, while our immediate consciousness is enthralled with the instant harmony. We cannot have it both ways: either there must be symmetry, so-called, or asymmetry—either a St. Ouen interior or a west front of Rouen Cathedral.

The idea that we must "balance" in irregular architectural composition is often a delusion, an impression, a legacy of lingering sympathy with exact equal-sidedness, itself largely the outcome of habitual elevational display of architectural device. The lion is sufficiently like the unicorn to balance in heraldic composition; sufficiently unlike to give individual interest to dexter and sinister hands. If we duplicate either the real or the mythical quadruped, we certainly attain exact equal-sidedness; but sameness is substituted for variety. This, by the way, demonstrates the fundamental difference between asymmetry and symmetry, so-called. We cannot, however, deal with architectural mass as the herald employs lion and unicorn. Divergent "twin" towers to cathedral west-ends may have a certain quaintness; but we generally feel dissatisfied, or unconvinced. The failure may, perhaps, be accounted for as the result of an attempt to graft asymmetry on symmetry, which we have endeavoured to show is not possible. We must either produce the monumental, equal-sided building, or start away on a new plan, based on quite a different principle. Small variations in detail are added charms in many symmetrical compositions; but a great belfry is not a detail.—The Building News.

A coat of high-temperature extra-heavy stack paint applied to the brick boiler settings in the plant of the Springfield (Ohio) Light, Heat and Power Company increased the natural draught through each furnace by 0.15 in. The manager of the company conceived the idea of experimenting with paint on the boiler settings, and it was under his direction that the first trials of this draught-increasing idea were made at Springfield. Two men were placed at work on the side of a setting, and even as they worked it is said that an observer at the draught gauge could detect the upward trend of the water column. When the painting of one setting had been finished, the workmen began on another, and as the pores of the brick setting of each unit in the boiler-room were sealed with paint approximately the same increase in draught reading was noted.

Crib, ready for launching.

The New Government Dock on Burrard Inlet, Vancouver

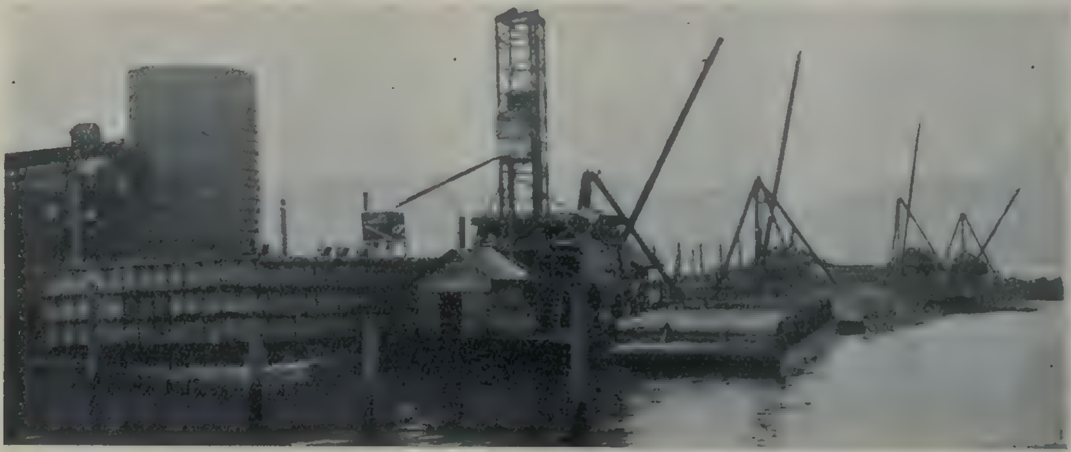
THE accompanying views are of the construction—now in progress—of the new Government dry dock and grain elevator on Burrard Inlet, Vancouver. The estimated cost of the two structures is $2,500,000. The new dock is being built in anticipation of the increased shipping business which Vancouver will receive as a result of the completion of the Panama Canal. When completed the dock will be one of the finest on the Pacific coast. It will be the largest of the Vancouver docks, and it will provide all accommodation, including railway tracks and warehouses.

The contractors, Messrs. Henry, McFee & McDonald, commenced operations on April 1, 1914, and they expect to have the dock completed by midsummer, when the erection of the elevator will be proceeded with. The contractors for the latter work are Messrs. Barnett & McQueen, Fort William.

The structure will be 800 feet long and 300 feet wide, with slips on the east and west sides 130 feet wide. The depth of water in the slips and at the face of dock will be 36 feet at low tide. It was necessary for the contractors to put in equipment costing some $130,000 in order to handle the work advantageously, the drill scow alone costing $58,000. Nearly 120 ft. in length, it carried twelve separate engines and five drills, with their steel towers. The drills were moved along on tracks, thus permitting a line of seventeen holes to be bored into the rock at regular intervals without the scow having to be shifted. Dynamite cartridges were forced into the holes through tubes, and generally a whole line of charges were exploded at once. The broken rock was removed by the Pacific

Anchor bolts on crib for holding reinforcing rods.

Crib in position, partly submerged.



Giant Mixer, with travelling bunkers. Capacity, 40 cubic feet a batch.

Dredging Company's big clam-shell dredge, the material being loaded on barges and dumped in deep water. As the drill scow had to cover the area twice in order to reach the depth desired, some idea may be gained of the enormous quantity of rock that had to be removed in order to prepare the foundation for 23 huge timber and concrete caissons which will comprise the substructure. These cribs are approximately 88 x 40 ft. with a depth of 39 ft. They are built of 12 x 12 in. timbers, the bottom layer of each being 12 x 18 in. Cemented and made watertight, the cribs were floated into position and sunk, the filling required for each one being about 4,000 yards of sand and gravel. Nearly all the cribs are now in place, and work is being rushed on the superstructure and the huge concrete sea-wall which will enclose the entire dock. This wall is of solid concrete, 14 ft. wide and 40 ft. in height, the foundation being on solid rock.

The dock will contain 11,000,000 feet of timber, 900 tons of steel, 30,000 yards of concrete and nearly 100,000 yards of sand and gravel fill. In addition, about 500,000 feet of fill material will have to be placed after completion to level up the dock surface and approaches. Spur tracks from the C. P. R. will run into the dock warehouses and alongside the elevator and slips, thus facilitating the economical and speedy handling of cargoes and parcel shipments.

Seven derricks have been in constant use handling the timbers and other material; three of these are on shore and dock, the others being stationed off-shore to handle the fill material from scows and also the concrete coming from the huge mixer, which has a capacity of 40 cubic feet and carries its own bunkers.

The first crib was sunk in place January 18th, on the west side of the dock, the others following at the rate of one about every nine days. The filling to the required level occupied about three days more.

Painting Structural Iron Work

By A. Ashmun Kelly

FORMERLY, and even yet, to a large extent, it has been the practice to give structural steel a coat of some alleged protective paint, although many architects and building engineers prefer having the metal delivered uncoated. There is much to say in favor of this latter plan. First, the exposure for a time to the weather frees it from much of its loose scale. Then the painting done at the mill is usually done by unskilled labor, and therefore the paint is not applied properly, and the uncleaned metal is covered up so that it cannot be inspected. It need not be said here that the metal must be made perfectly clean before any coating is applied. The prime coat should be applied just before assembling the parts.

Rust and scale must be removed. Rust will continue even under paint, so that it must be removed. If the metal is allowed to stand exposed to the weather too long it is apt to rust, and for this reason it should be painted before assembling the parts. Then the painting can be done under the supervision of the architect or other person on the work and having supervision. And it is important that the paint be applied while the metal is dry, and, if possible, when the metal is not too cold.

The coating should be heavy rather than light, because, in general terms, the measure of protection afforded by a paint is proportional to its thickness, granting that the film is hard, elastic and adhesive. And there should be harder brushing in of the paint than on any other surface, because of the non-porous character of metal, this rubbing is causing the paint to adhere better.

The reason for having a thick paint film is that it will keep out moisture better than a thinner coat, and the more pigment the better the protection; linseed oil not being moisture-proof. Linseed oil alone when applied to metal affords almost no protection at all; yet when red lead is mixed with it we get a paint that is nearly ideal. Such paint is hard, yet elastic, thick, and very adhesive. It is possible to mix as much as 33 pounds of dry red lead to a gallon of oil and get a good paint—one containing the maximum of pigment. In fact, it is the paint for iron or steel work of all kinds. It is an inhibitor of rust, and is so dense a coating that water will not penetrate it, though it will any ordinary oil and white lead paint. Naval vessels are coated with it, and the mammoth steel members, as well as all minor members, of the Panama Canal are coated with it; in fact, practically all structural steel is coated with it. Engineers and chemists agree that at least two coats of red lead paint should be applied first, after which any purely decorative paint may be given.

When painting metal work it is a good plan to make each red lead coat a little different in shade, by adding some lamp-black to one coat. In this way the inspector can detect any faulty work. The lamp-black will not do any harm, but is rather a valuable addition to the paint.

In preparing the metal for painting the surface must be freed from scale, moisture, grease and rust. This can be done with benzine for washing off grease, and with steel wire brushes for removing mill scale. Any holes, large or minute, should be filled with a proper putty before painting. Be careful to paint all parts, for if the metal is allowed to touch, face to face, rust will follow; local galvanic action is excited, causing the corrosion.

When it is necessary to repaint structural steel work the work should never be done in winter, or in wet weather. Take as dry and warm a time as you can. The cleaning off of the metal must be very thorough, removing all rust or scaly paint, etc. All rusty parts, or where the paint has come off, should be made clean and given a coat of red lead paint, after which the entire surface may be painted with any desired paint. For repainting such surfaces we would advise the addition to the paint, made with raw oil as the chief thinner, of a little benzol or turpentine. This is for the first coat only; though turpentine in a small amount will do no harm on any coat, except that it is apt to dull an oil finish if in excess, though it will make a paint much harder. Benzol, being a solvent of oil, is not advised on any but the priming coat.

Another very good pigment for iron or steel work is iron oxide, though the red lead paint is the very best for contact with the metal, after which the iron paint may be applied, if its color is not objectionable, and this may be modified with lamp-black. Oxides do well in paint subject to much exposure; hence iron oxide and lead oxide (red lead) are good pigments. Zinc white is an oxide—true—and a very desirable pigment or base, but it is too hard, is non-elastic, and therefore does well only in connection with another pigment having more elasticity, such as white lead.

Red lead paint should be mixed and used the same day, as it oxidizes so readily that as a paint it soon forms a cement; besides which it settles in the pot—though there are some red leads that do not settle very much, if at all. Mix with raw linseed oil, the following being a typical formula: To 100 pounds dry red lead add, for summer painting, 4 gallons raw oil, and for winter painting use boiled oil; add also in either case 1 gallon turpentine, and ½ gallon japan driers for the raw oil, none for the boiled oil. By adding 10 ounces dry lamp-black to the 12 pounds of dry red lead, with oil to make a gallon of paint, you will get a colored red lead paint as previously mentioned.—By Ashmun Kelly in The National Builder.

In the construction of their colonial railways, states the Railway Age Gazette, the Germans apparently were not unmindful of their defence. Their greatest system, the Dar-es-Salaam-Tanganyika Railway, commonly called simply the Tanganyika Railway, was completed last year, and is approximately 780 miles long. At Tabora, 530 miles inland from Dar-es-Salaam, where many great trade routes converge, the Germans constructed a massive modern fortress. The great value of the railway as an economic factor lies in the fact that it borders on three great inland seas—Nyassa, Tanganyika, and Victoria Nyanza—thus linking up the trading centres, the great lake system of Central Africa, and the river Congo with the east coast ports.

Hydration of Portland Cement*

SOME useful results obtained by the United States Bureau of Standards have lately been made public in a paper by Messrs. A. A. Klein and A. J. Phillips, describing various hydration experiments on calcium aluminates, calcium silicates, lime burned at different temperatures, and high silica, low silica, high iron, and high magnesia Portland cements. The subjoined notes refer only to the experiments on the last mentioned class of products.

On the hydration of cement, the first constituent to react is the aluminate, with the formation of amorphous hydrated tri-calcium aluminate, with or without amorphous hydrated alumina. Sulpho-aluminate crystals are also formed, and the low-burned or finely-ground calcium hydrates. This occurs within a few hours after the cement is gauged. The next compound to hydrate is the tri-calcium silicate. This commences within 24 hours, and is generally completely hydrated within 7 days. Between 7 and 28 days, the amorphous aluminate commences to crystallise and the beta-ortho-silicate, the least reactive compound, begins to hydrate. The 24-hour strengths are due mainly to the hydration of the aluminates and of any fine-grained, low-burned lime present. The large increase in strength between 24 hours and 7 days is due mainly to the tri-calcium silicate hydration. The increase between 7 and 28 days is due to the hydration of the beta-ortho-silicate. Where there is a decrease in strength during this period it is due to the hydration of very high-burned free lime, as in very high-burned, high-limed cements, or to the crystallization of the aluminates, as in high alumina cements. The iron compounds in a cement are resistive to hydration, and the iron does not form crystalline hydration products, but occurs as a rust-like material.

The initial set of cement is affected by the action of small amounts of electrolytes in retarding coagulation of the aluminate material. With a limited amount of water, as in normal consistency mixtures, the aluminates coagulate and separate from supersaturated solutions as amorphous bodies, the rate of coagulation being affected by such small quantities of electrolyte as to nullify the possibility of the reaction being a purely chemical one.

Failure of cement in accelerated tests is due to the growth of large calcium hydrate crystals. The disrupting action of these results from the pressure caused by growing crystals. Cement will fail in the boiling test which contains lime sufficiently fine and high burned, so that during boiling it will hydrate and crystallize. When a cement passes the boiling test but not the autoclave test, it contains lime so coarse or high burned as not to hydrate in the boiling test, but only in autoclave, owing to the high temperatpre and pressure employed. Some cements will pass either test only after ageing. In this case, aeration with sufficient water to allow solution and crystallization causes the lime to hydrate as amorphous hydrate, and in the accelerated tests there is no crystallization and no disintegration.

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*From a report of the U.S. Bureau of Standards.

Concrete Failures:—An Analysis of Their Contributing Causes*

By R. S. Greenman

CONCRETE is said to be its own best inspector, and it is a well-known fact that defects in concrete will sooner or later make their presence known. For every fault there must be a reason. The reasons for poor concrete have been proportioned as being 90 per cent. due to poor workmanship, 8 per cent. due to poor aggregates, and 2 per cent. to poor cement. These percentages are not the result of tabulations, but are those prevailing in the minds of many who have had considerable opportunity for inspection of concrete, both good and bad. But whether or not these percentages are correct, the statement raises the question: "What are the reasons for poor concrete and how do we determine these reasons?" It is a certainty that neither a laboratory test nor a field inspection alone will give them, unless, of course, it be a simple failure. Yet there are people who will examine a piece of concrete in the laboratory and offer a solution of the problem simply by tests made there. And, again, an inspector will look over a piece of concrete construction, and, with no knowledge whatever of the characteristics of the materials used, nor of the method of making, will attempt to tell how such and such a condition developed. Concrete failures can be explained only after thorough investigation by men who know good or bad concrete from long and close acquaintance, and whose minds are of an analytical and judicial temperament. The more one sees of concrete, the more one becomes convinced that it is the most abused structural material being used. The science of making concrete has been looked upon too generally as being very easily learned, with the natural result that a great deal of poor concrete has been made. Now, however, builders, contractors, and engineers apparently desire to make concrete that will meet the standard in quality required of other materials; and yet, with all the precautions now being taken, there is still a large amount of concrete that is not satisfactory. The larger the work, the greater the care taken; and, vice-versa, the smaller the work, the greater the carelessness, and the greater is the ratio of the failures, and it is the sum total of these failures that makes the loss caused by poor concrete so great. In trying to solve a problem of poor concrete, the elements to be investigated are the three already mentioned—cement, aggregates, and workmanship—and water. The common tendency is first to place the blame upon the cement; but if we find that in accordance with good and generally common practice, the cement has been tested and has met the standard requirements, the cement then becomes a negligible factor; but if it has not been tested, it must be considered as a possible cause, and it may become a large item in the study. We must admit that since so much stress has been laid upon the value of having cement tested before use, and since it must indeed be a small work where it has not been so tested, the percentage of failures due to poor cement has been reduced to a very small amount. If the next element had been given equally as thoughtful consideration to its use, there could not be so much poor concrete due to poor aggregates. The strong and weak points in both the coarse and fine aggregates have been too often neglected. The coarse aggregates can usually be judged by easy inspections, but sand or other fine aggregates need very careful examination. The characteristics of sand—such as the grain, the grading, the cleanness, and its freedom from organic impurities and excess of loam—are items of knowledge which are obtainable mainly in the laboratory, but which are very essential for the correct diagnosis of a concrete failure. The effect of workmanship is by far the largest factor, and in it all others are included, for a poor workman can destroy the value of the best materials. Under the head of workmanship must be considered such items as design, proportions, placing, and actions resulting from heat, frost, electrolysis, etc., which should have been taken care of during the process of making and preservation.

As another element of importance, it must always be kept in mind that the water used in making the concrete, or which may come in contact with it, may prove to be a very influential factor for harmful results. Then, if one is given a concrete failure to diagnose, one must look for a reason under cement, aggregate, workmanship, and water. As stated, the easiest explanation is to look for some fault in the cement; but if, as has been suggested, the cement has passed the usual tests, then other reasons must be found. To find them requires that the investigator shall first know conditions and causes of failures; but these will not be further discussed except to point out the way to the reason; then the investigator must attack the problem with an open mind—that is, he must not jump at a conclusion and expect to be able to work out an explanation around that conclusion. Then it is even more essential that the investigator shall have had an opportunity to learn the results of tests, or to make tests that will enable him to judge the probable actions from the characteristics of the aggregates. Also a very careful examination of the concrete in place is generally an absolute necessity. To attempt to outline a plan for procedure in this examination would be folly, since each individual case has conditions that are decidedly its own, and the law of probabilities makes possible many combinations of causes which can be worked out only as one would solve any involved research problem. Clues must be sought, and a sharp eye, a quick ear, and a questioning tongue must be alert to grasp a clue and pursue it to a definite ending. If anyone should be sceptical of the efficiency of this method, it is possible that a few illustrative cases, selected from a large number of diagnoses, may convince that one that the method has proven, and can prove, successful, far more than is generally expected.

Failure Due to Water

A highway was being built, and the plans called for several new concrete culverts. All but one of these culverts "set up," or hardened, nicely. This one did not; and yet the same cement, sand, and stone had been used as in all other culverts. A reason for the failure of the one culvert was desired. It was found that the brook which flowed through this particular culvert passed in its course the plant of a company engaged in the manufacture of medicine from herbs. The refuse from the plant so loaded the water with organic matter that it prevented a proper hardening of the concrete. No one connected with the construction of the culvert knew that water so contaminated would have that effect, and the complaint came in that the cement was not acting properly. The brook was temporarily diverted, other water was used, and the concrete acted normally. A condition had existed there which would not have existed in city water, but which is found frequently in the country, especially in wooded sections. To detect the cause, one had to know that certain elements, such as tannic acid, alkalis, salts, etc., foreign to most waters, do affect concrete.

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*Abstract of a paper read before The American Society for Testing Materials.

Failure Due To Sand

For an illustration of the effect of a poor quality of sand, consider the following case:—

A cry of alarm come in from an engineer that the concrete in an important bridge abutment had been in place for over two weeks, and that in attempting to remove the forms it was found that the concrete was still so soft that it could be cut out with a knife. A brand of cement new to the work had been used, and the blame was, of course, placed on it. An examination showed that a footing for the abutment had been made of the brand of cement first used on the work, and that, although ten days older, the concrete could easily be cut with a knife. The evidence eliminated the cement. Examination of the sand showed it to be well-graded sharp sand, but a clue was furnished by some yellow-coated grains. The investigator had already had considerable experience with similar sand grains. A trip to the sand-bank showed just what he expected to find. The bank had not been stripped of a top layer of yellow-coated sand, which gives a sand with which it is mixed a tendency to delay very materially the hardening of the concrete in which it is used. In time, usually several months, the concrete will harden, and there is ultimately no harmful effect apparent. Lack of knowledge of this particular quality has caused an investigator of another piece of work to tear it out and rebuild.

Failure Due To Stone

A very unusual condition existed in another case, but it emphasises strongly the need of following clues. A concrete wall was apparently disintegrating, due, as the engineers believed, to free lime in the cement. In various places on the face of this wall there appeared what can best be described as "blisters." By prying off these blisters, there were produced small cones about 6 ins. in diameter and 3 ins. in height; and in the apex of each could be seen a small, yellowish-white spot about the size of a small marble. The trouble was clearly not a case of free lime in the cement. One unusually large blister enabled the author to dig out from the apex a soft stone about 1½ ins. in size. This stone did indicate the presence of free lime, and, after a few weeks on the author's desk, slaked into a powder. Examination of the stone composing the coarse agregate soon brought out the following:—

The crushed stone all came from the same quarry, but some came by a steam railroad and some by an electric railway. No concrete made by the former showed blisters. Concrete made from stone delivered by trolley did, but why? It seems that in the course of transportation by the trolley route the stone was conveyed in waste dump-cars, across the grounds of the company owning the quarry and conducting a plant in which limestone is an essential raw material. These dump-cars had not ben cleaned carefully, and to the good stone were added some small quantities of stone that had been through a chemical process and were on the verge of disintegration. In the concrete their expansive force blistered the face. By forbidding further deliveries by trolley the trouble was stopped. These may be considered extraordinary cases, but it is the out of the ordinary that makes trouble; if they were not the extraordinary, they would probably have been guarded against. They are, at least, typical of points for which one must look, if one would explain failures in concrete.

Failure Due To Workmanship

Failures due to poor workmanship are seen so often that, instead of citing particular cases, it will be sufficient to note briefly some causes or results. Failures from faulty design are shown in the mode of failure. The lack of proper proportioning may be clearly seen in a fractured surface; the grading of the aggregates is also similarly noted; and poor mixing and improperly placed concrete readily show themselves. All these are evident to an eye trained to know good or bad concrete. The failure to take care of laitance is made apparent by the seams that are bound to result from such a failure.

A concrete may be dense, but not sound and hard, and "sounding" with a hammer will show up this characteristic. Too wet a mixture with fine sand or silt or a crushed dust used as fine aggregate, may be a cause. It may be sound and hard, and yet be poor for certain uses because it is too porous. By scratching the face of unbroken concrete with a dull instrument, one may sometimes judge of proportions used, and, in its early stage, can also judge somewhat as to the rate of hardening. A pocket glass in the field, and a microscope in the laboratory, help materially in determining the density, and approximately the ratio of cement and fine aggregate to the coarse aggregates. The naked eye is all that is needed to observe concrete spoiled by sweepings of sawdust, shavings, or blocks, or by waste carelessly dropped into a form. Lack of protection to fresh concrete from the sun or unusual heat, may be noted by a "dried-out" and rapidly dusting surface; and from frost, by a flaked and scaly surface.

Influence of External Forces

When concrete has apparently been good for a considerable period, and has then begun to disintegrate, the reason for the failure must be sought in the character of disintegration, whether it may be due to changes in the elements or forces that have entered into it. If due to an internal influence alone, the fact will be noticed by the granular breaking up of the concrete. If due to an external force, such forces as sea-water, alkali salts, or electrolysis will be under the influence of any of them. For many years, all the failures of concrete were considered as being due to the formation of certain chemical reactions; but, as it is commonly acknowledged at present that an impermeable concrete will stand in sea-water as well as elsewhere, although subjected frequently to more severe actions than other concrete, its failures are due frequently to the same causes as those of other concrete, and therefore the same examinations should give the same results. Similarly, since electrolysis is considered as a cause for the breaking-down of concrete, the liability of concrete being affected by its influence will depend upon whether the concrete comes under the influence of an electric current. If it does, then its influence needs to be examined. If it does not, then the examination should also follow the usual method.

The value of laboratory tests and analyses should not be overlooked. While, perhaps, not giving as definite information as a field inspection, they should be used to the fullest extent to help establish the strength or weakness of a reasonable theory for the cause of failure. Where time will permit, laboratory tests of concrete made of the aggregates under as nearly as possible the same conditions, will give results that should aid in determining the fault in the original. Test specimens so made and treated should give practically the same results, and, when compared with test specimens made under ideal conditions or with standard materials, should give the investigator the reasons for the failure. All means possible should be used by an investigator in making his examination; and his conclusions must be drawn only after he has considered the failure from every probable cause with reason and fairness. The object of the examination is either to place responsibility or to guard against failures, and right conclusions are the only ones that should be drawn if justice to either object is to be given.

Detecting Underground Leaks

Methods Employed by Numerous Cities:—Isolating Distribution System Districts—By Sound at Valves, Services and Hydrants—Other Methods

UNDOUBTEDLY most, if not all, water-works distribution systems contain leaks of greater or less importance, by which amounts equalling in some cases thirty to fifty per cent. of the total amount entering the mains escapes underground. Various methods are employed in different cities for discovering the existence of such leaks and for locating them. Descriptions of such methods by several score of superintendents were secured recently by The Municipal Journal, and a summary of their replies is contained in the following paragraphs.

It is believed by some of those reporting that leaks (some claim all leaks) make themselves apparent on the surface, because of the sandy soil (the streets being unpaved). In other cities it is claimed that leaks show on the surface because the soil is clay. Still others state their confidence that leaks show on the surface, but do not state the kind of soil. The "pressure in the mains is high and drives the leakage to the surface" in two cities. In one town "Underground leaks show upon the surface unless the water finds its way to the sewer, in which case it probably is not discovered. As the per capita daily consumption is less than 50 gallons, this would seem to indicate that very little is lost in this way."

Where the distribution system is examined for leaks, perhaps the most common method is to isolate one small district after another by closing valves on all lines leading to it (this being done soon after midnight or whenever the large majority of the citizens retire) and determining whether any water would leave this district if water were admitted to it, by opening a valve slightly and listening for the "singing" of water entering through it; by installing a small pipe (say 1-inch) connection around one of the closed valves, a meter being inserted in the connection; or by carrying a fire hose from a hydrant in the isolated district to one outside it and under pressure, placing a meter on this hose line and thus feeding the isolated district through the meter. In any case the reliability of the test depends on all the closed valves being perfectly tight. To determine this, open a fire hydrant in the district before all the valves are closed and let it fill up. After all valves are closed, open the hydrant valve again; if the water flows out of the nozzle (or rises in the barrel), some of the valves are leaking—or else water is flowing back from some of the house plumbing into the mains, but the latter will diminish rapidly and finally cease, while the leakage would remain constant or even increase as dirt is washed out of the valve seat. It is possible that the leaks in the mains would continue to flow and balance some valve leakage; but as the open hydrant removes all pressure, this leakage probably would not be considerable. In addition to this, each valve should be tested by a water phone of some kind for leakage, whether the other methods are used or not. The return flow from houses could be prevented by closing all curb cocks before making the test, these cocks themselves having all been previously tested (on the previous night, preferably) by water phone.

This method of course tells only whether there is a leak or leaks in the district; its exact location must be determined in some other way; by subdividing this into smaller districts, if there are valves permitting of this; by driving a bar to contact with the main at intervals and listening with the water phone and looking for the appearance of water when the bar is withdrawn; by examination of sewers at all manholes (though flow in these may of course be natural ground water); or even by digging down to the mains at the low points in the district on the assumption that leakage water will follow the mains down hill, and "following up" any flow found there.

In Talladega, Ala., no systematic test for leaks is made, but when there is reason to believe that water is being lost in this way the distribution system is isolated by sections as described. A number of cities use the same method, listening at valves for leaks or determining them in ways not stated .

Maynard, Mass., Buffalo, N.Y., and Lancaster, Pa., use the method of connecting fire hydrants. West Orange, N.J., and Canisteo, N.Y., connect around a closed valve. Boston, Mass., uses a detector meter, which is a recording meter inserted in a line around a closed valve, as described. The same method, we understand, is used in Marietta, Ga., where one leak of 2,900 cubic feet in 24 hours was discovered, and several smaller ones.

Probably a number of other cities, which report using some variety of telephone receiver or microphone for detecting the noise of leaking, combine this with the isolated district method. The cities give the names of several appliances of this general character, such as aquaphone, sonoscope, waterphone, audiphone, etc.

Experience in several cities has appeared to indicate that considerable leakage may take place in the mains without being detected by aquaphone applied at the service.

In Pasadena, Cal., the total quantity of water delivered to one of the reservoirs is measured and is checked against the total quantity of water consumed from that reservoir as indicated by consumers' meters, and this shows a loss of 16.4 per cent. of the part of the total consumption delivered by this reservoir. Part of this, however, is used in flushing the mains, ditches and fire hydrants and in extinguishing fires, which amount is not metered.

In Mt. Carmel, Ill., when a leak is suspected along any particular line, an opening is dug down to the main. Leakage from the main always follows the pipe and will show at the hole and its direction from this opening may then be learned. Under a railroad crossing is always a bad place in soft earth on account of the vibration from trains.

Muscatine, Ia., makes routine examinations and finds about one-third of the consumption wasted. Frankfort, Ky., examines sewers for evidence of underground leakage. In Morgan City, La., pipes are about 2 feet underground and leaks are detected by sound or appearing at the surface. Winthrop, Mass., accounts for all pumpage except 21 per cent., in which is included water used for flushing sewers, sprinkling streets, building roads, filling skating ponds and extinguishing fires; the leakage is estimated therefore at about 10 per cent. Brookline, Mass., accounts by meters for all but 18 or 19 per cent. of the water pumped. Sedalia, Mo., examines sewers and laterals for evidence of leakage. Kalispell, Mont., uses test-holes over the pipe line. Livingston, Mont., tests by using pressure gauge—has found no leaks. Jamestown, N.Y., tests for the existence of leakage by shutting down pumps and noting drop in reservoir at night. Oneida, N.Y., uses needle bar for mains—has found no leaks in mains. Cincinnati, Ohio, considers leakage, if any, so distributed that cost of stopping would be greater than value of water saved. Duquesne and Ellwood City, Pa., use "an electric contrivance," but believe most all leaks of any size show up on the surface. Jeannette, Pa., has meter readers listening for sound—leakage usually found in poor joint on lead services or rusted galvanized service. West Newton, Pa., has found some of its biggest leaks by inspecting sewers from the manholes. In Clarksville, Tenn., service leaks from curb in are detected by meter (which is located at curb) or inspection. Pullman, Wash., has 13,000 feet of wood pipe and finds numerous leaks—has replaced 24,000 feet and 9,000 feet of steel pipe with Universal cast iron pipe in the last three years.

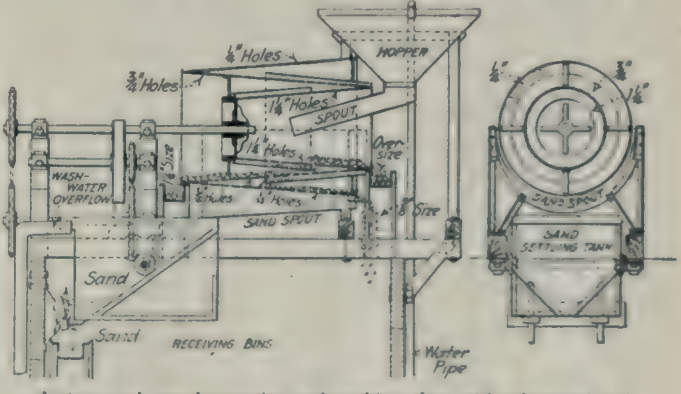
A number of cities have made, or periodically make, pitometer tests. The city of Winnipeg found 37 serious leaks, 201 medium, and 70 slight leaks in service pipes.

A paper read by Mr. M. McLaren before the American Association for the Advancement of Science deals with the use of electricity in the manufacture of Portland cement. The author says: "There are few industries in which the cost of power represents such a large percentage of the total cost of production as in the manufacture of Portland cement. Any means, therefore, which may be employed for reducing the amount or cost of this power must receive most careful consideration. A great deal of attention is being given to the development of more efficient methods of grinding, and while these efforts should be encouraged, the writer's experience indicates that the amount of power required to produce the same quality of cement varies little with the different types of grinding machines in common use, when given equally intelligent supervision. It is also believed that in no way can the cost of production be more materially reduced than by the extensive use of electric drive."

A Compact Screening Plant

A SPECIALLY compact plant for screening stone and gravel is made with telescoped revolving screens, so that three screens occupy the space ordinarily occupied by a single screen, while less shafting and a smaller structure are required. The screens are conical and are placed in opposite directions, all being connected to form one structure driven from one shaft. The construction is shown in the accompanying drawing.

The material is delivered by a spout to the interior of the smallest or inner screen, which has 1¼-in. holes, and the oversize of this falls out from the end into a spout or conveyor which returns it to the crusher. The material passing through this first screen falls upon a conical apron attached to the screen, which has ¾-in. holes. The 1¼-in. material passes out at the large end of this screen and is caught by a chute or conveyor. The finer material which passes through the perforations falls into a conical apron and is delivered to the upper end of the third and outer screen, which has ¼-in. holes.



A stone and gravel screening and washing plant with telescoped and concentric screens.

The ¾-in. material rolls out at the end of the screen, while the fine stuff which passes through the perforations falls into a trough or sand spout and goes to a settling tank or hopper. This hopper has an oscillating movement, causing the wet sand to flow out into another spout or conveyor.—Engineering News.

The method employed by the Niagara Falls Power Company for cooling its underground cables were described in a paper entitled "Effect of Moisture in the Earth on Temperature of Underground Cables," by Mr. L. E. Imlay. The scheme first employed was to circulate water through one of the vacant ducts adjacent to the occupied ducts. Later porous drain tiles were installed parallel to and above the cable ducts so that water flowing through the tile could percolate through the ground surrounding the cable and finally be carried away through agricultural tile drains below the ducts. The approximate temperatures of the cables were ascertained by inserting resistance thermometers in ducts adjacent to the cables which were supposed to be the source of heat. The temperature of the cable insulation next to the conductor was determined from these readings by referring to a chart based on a formula given by Messrs. Atkinson and Fisher in a paper presented before the American Institute of Electrical Engineers in 9913.

Care and Efficiency in Priming Dynamite

Increasing the Efficiency and Decreasing the Uncertainty of the Harmless Looking but Highly Potential Stick of Dynamite

MANY think that the priming of a dynamite cartridge is of very little importance—if the dynamite goes off, that is all there is to it. It is not widely known that the success or failure of a good many blasts depends on the position of the detonator—blasting cap or electric blasting cap—in the dynamite. Not only the amount of work done depends in a large measure on the priming, but also the safety of the loading operation is affected in many instances by the position that this detonator occupies. Many accidents have occurred and many men have been killed in loading holes with a primer made so that the detonator became jammed or wedged in the hole and exploded when the blaster endeavored to force it down.

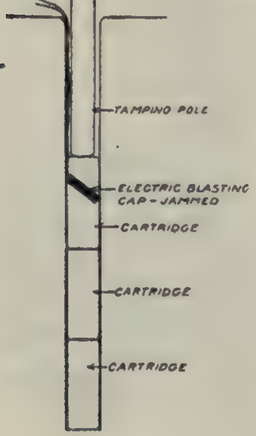


Fig. 1

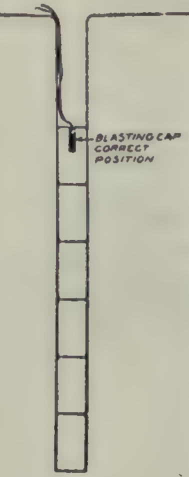


Fig. 2

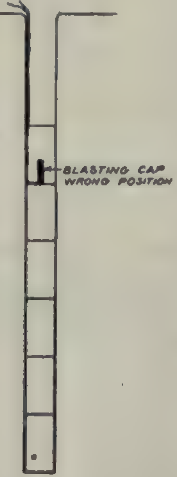


Fig. 2b

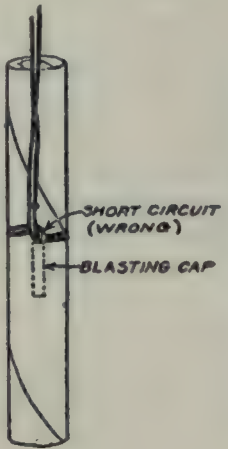


Fig. 3

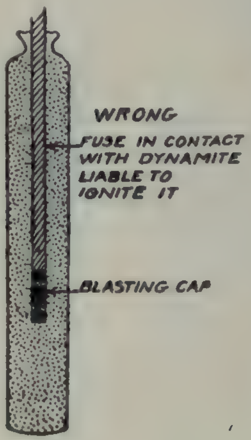


Fig. 4

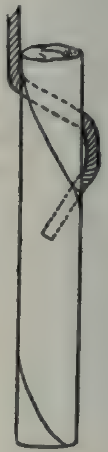


Fig. 5

The points to be borne in mind in making a primer are the following:

The detonator—and by detonator is meant either a blasting cap or electric blasting cap—must be in such a position that it cannot become jammed in the bore hole, as in Fig. 1.

The detonator must be in such a position that it will not be struck by the tamping stick.

The detonator must be fastened to the cartridge in such a way that when the wires or fuse are held in one hand by the blaster, and the cartridge seated with a tamping stick held in the other hand, the detonator will not pull out. The detonator must be entirely embedded in the dynamite.

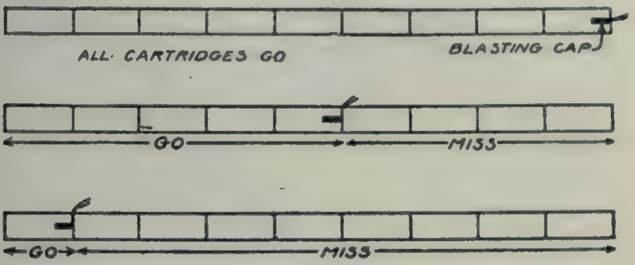
The loaded end of the detonator, or the closed end, or the "business end" should point toward the bulk of the charge (Fig. 2-A), not away from it (Fig. 2-B). The detonator should not be secured by metal wires, etc.

With an electric blasting cap, the wires should not be fastened on with a half hitch, as in Fig. 3, for although this practice is very common, there is always a chance of a short circuit occurring, especially when high-voltage power currents are used for firing.

With blasting cap and fuse, the fuse must not come in contact with the dynamite, except for about a half-inch next to the cap (Fig. 4). "Lacing" fuse through dynamite causes more burned charges than anything else (Fig. 5).

The maximum detonating effect of a blasting cap or electric blasting cap is out from the closed end. If you place a dozen cartridges of dynamite, end to end in a straight line on the ground, and fire a blasting cap in the end cartridge, with the blasting cap pointing towards all the other cartridges (Fig. 6), the entire line will go off, but if you put this primer in the middle of such a line (Fig. 7), some of the cartridges back of the detonator, that is, those away from which the detonator is pointed, will often fail to explode. If you put the primer cartridge at the end of such a line, pointing it away from the line, that is, pointing it towards the open air (Fig. 8), generally the primer only will explode. This does not always happen in a bore hole, because there the explosive wave is strongly confined, but this shows a tendency of the dynamite, which is in the opposite direction from the closed or "business end" of the detonator, to misfire. Several years ago this was demonstrated to a skeptical individual in a quarry shot, where there were 27 holes, each hole containing from 19 to 21 cartridges of dynamite; 13 of the holes having the detonator in the next to the last cartridge and pointing downwards, that is, toward the bulk of the charge; the rest of the holes having the detonator in the same cartridge, that is, the next to the last, but reversed, pointing upwards. These holes were all thoroughly tamped with sand and fired at the same time. While all the dynamite in both sides exploded, where the detonator pointed downwards the rock was broken and cleared from the ledge below the bottom of the holes; where the detonator was pointed upwards, about one-third of the distance from the bottom of the holes upwards, the rock was broken up but left in place. This showed that when the detonator pointed downwards, the full power of the dynamite was realized; where the detonator pointed away from the bulk of the charge, the full power was not realized, but a great deal was wasted.

When a cartridge of 40 per cent. straight dynamite is suspended vertically in the air, and a blasting cap supported at right angles to it, and pointing directly at it (Fig. 9) is red, the dynamite will explode at a distance of 24 ins. from the blasting cap, but if a cartridge and blasting cap are hung parallel with each other, that is, the blasting cap pointing either straight up or straight down and parallel to the dynamite cartridge, so that it does not shoot directly at the cartridge (Fig. 10), the dynamite will not explode until it is brought to a distance of 15 ins. or less. When the blasting cap is horizontal and the cartridge of dynamite hung vertically and the cap supported at the level of the middle of the dynamite cartridge but pointed so that it does not point directly at the dynamite but a little to one side (Fig. 11), this distance where an explosion occurs is lessened still more. When the cap is pointed directly away from the dynamite cartridge (Fig. 12), it will not explode the dynamite cartridge every time, even when within 4 ins. of it.



Figs. 6, 7 and 8.

The ideal primer with an electric blasting cap would be one where the detonator lies directly in the axis of the cartridge near the middle, and with the wires secured to the cartridge, in such a way that they could not possibly pull out, by some strong non-conducting material like string. By using a curved puncher (Fig. 13) it is possible to get an electric blasting cap almost in this ideal position, where it may be held in place securely by taking a half hitch with a piece of string around the wires, carried once or twice around the dynamite cartridge and tied tightly with a square knot (Fig. 14).

Another way of priming with an electric blasting cap without using string is to punch a hole through the cartridge about 2 ins. from the end and lace the electric blasting cap through this and insert it in the side of the cartridge.

With short wires, 4 ft. or less, the ends may be passed through this hole after the cap is inserted in the cartridge (Fig. 15), but with long wires it is apt to either make the hole so large that it does not make a secure fastening, or it may even cut the cartridge in two.

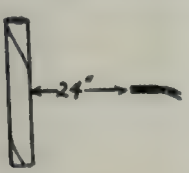


Fig. 9

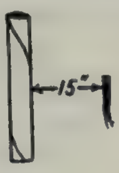


Fig. 10

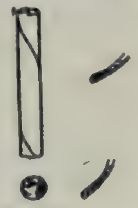


Fig. 11

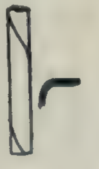


Fig. 12

With blasting cap and fuse, inserting the blasting cap in the side of the cartridge about one-third from the top and tying it tightly with one or more pieces of string, keeps the cap away from the tamping stick, and if carefully done with a curved puncher, places the cap almost in the axis of the cartridge (Fig. 16).

The orthodox method of opening up the paper at the top of the cartridge, punching a hole in the dynamite, inserting the cap and fuse into that, and then tying the paper down around the fuse as in Fig. 17, gets the blasting cap in a good position, but is a difficult operation to perform on account of the tendency of the string to slip off the paper and the difficulty of getting the string tight enough to prevent the fuse from pulling out. It also is liable to kink the fuse abruptly if the primer is seated firmly with the tamping stick.

Dynamite, when strongly confined in a bore hole, burns very rapidly when it is ignited, and on this account the lacing of the fuse through the dynamite cartridge is a practice which is strongly condemned by all explosive manufacturers. It seems strange that very much of the dynamite would burn before the cap would explode, but the fact is, dynamite burns very much more rapidly when confined than when in the open, and it has been known to burn up entirely in a bore hole which contained a perfectly good cap without any of the dynamite exploding, the cap, of course, exploding and doing no work. Burning dynamite makes a large quantity of exceedingly poisonous fumes, and a number of fatal accidents have occurred from dynamite burning up in the bore holes in mines and tunnels, due either to lacing the fuse through the cartridges, or from other causes, such as matches, sparks or burning oil dropping into the charge bore holes. These fumes from burning dynamite are so frightfully poisonous that no chance whatever should be taken of a charge catching fire, especially when it is so easy to prevent it by taking the proper care in preparing the primer.

The bane of blasters in mines and tunnels is the smoke and fumes from the explosive, and while no explosive has yet been invented which does not give off more or less irritating fumes, the quantity of fumes given off can be materially decreased by insuring complete detonation of the charge by using the strongest obtainable blasting cap or electric blasting cap, by inserting the primer in either the last or next to the last cartridge in the hole, and placing the detonator so that the "business end" points towards the bottom of the hole. It is advisable to place one cartridge on top of the primer as it serves to cushion the primer from the tampering stick when used for packing the tamping. The stronger the confinement and the larger the detonator, the more perfect the explosion will be, and the less the amount of noxious fumes.

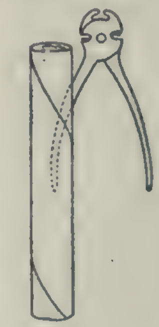


Fig. 13

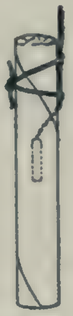


Fig. 14

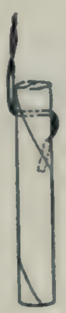


Fig. 15

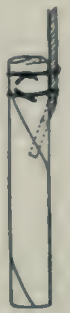


Fig. 16

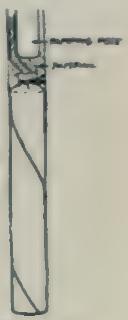


Fig. 17

Discussing the position of affairs in the Canada Cement Company, the General Manager, Mr. F. P. Jones, said that the recent order of 2,500,000 barrels of cement received from the Dominion Government was for delivery extending over four years. In addition to this, the company had orders for the Halifax dock improvements, Quebec dry docks, Montreal harbor elevator, Winnipeg waterworks development and other large undertakings running into a total of 4,000,000 barrels, including the order already mentioned. These were for delivery over the next four years, and being the equivalent of 1,000,000 a year, the company felt that it had a good basis for operations.

Processes Available for the Treatment of Industrial Wastes

THE problem presented in the treatment of industrial wastes is rapidly gaining in importance, both to manufacturers and cities. The sanitary engineer thus finds his field rapidly widening in this direction, and a study of the treatment processes available is profitable at this time.

Industrial wastes containing putrescible matter create a nuisance when discharged into water courses. Such wastes entering sewers also add to the load on plants treating domestic sewage. The latter possibility must now be kept in mind in designing new municipal sewage treatment plants. Industrial wastes may also cause deposits in streams or an oily scum on the stream's surface. Some such wastes give a bad taste to water and badly taint the flesh of fish. Thus petroleum refinery wastes give a kerosene taste to water and gas and tar works wastes taint fish.

Sometimes, but by no means always, the treatment of industrial wastes leads to the recovery of valuable by-products and is carried on at a profit. Thus fine screens in pulp mills save much finely divided pulp. In general it is unsafe to assume that a direct profit can be made in the treatment of industrial wastes. However, an indirect return is received by removing the cause, and subsequent cost, of litigation.

In some small plants the facilities of the large plant for making by-products are lacking. However, careful inspection by an outside engineer will frequently show leaks which can be stopped at small expense with comparative profit to the manufacturer. In the tanning industry pieces of skin and even whole hides have been lost to the sewer by lack of proper floor screens and catchbasins. In one wool scouring plant so much wool went down the sewer that the owners refused their operating engineer the privilege of keeping the catchbasin clean for the wool recovered.

In the location of new plants a manufacturer should bear carefully in mind the almost certain probability of regulation of the discharge of waste. Hence it would seem wise to locate plants producing large amounts of waste difficult of treatment on the largest bodies of running water available. Unfortunately, in many cases this is not done, and a plant is built on a stream which furnishes hardly enough water for an adequate water supply, and then a nuisance results.

CLASSIFICATION OF WASTES

From the physical and chemical standpoint the various wastes can be classified as follows:

1. Wastes carrying sediment or suspended matter. (a) Heavy mineral matter, such as marble dust, ashes, etc., usually inert. (b) Heavy matter, such as the product of chemical reaction, as tarry wastes from gas works, residues from ammonia works, etc. (c) Heavy organic matter—which may be highly putrescible, or comparatively inert.

2. Wastes carrying little or no sediment. (a) Containing soluble organic matter, which may be highly putrescible. (b) Containing chemicals. 1. Eager to absorb oxygen. 2. Inhibiting bacterial action.

3. Wastes carrying both suspended and soluble matter.

4. Wastes carrying floating materials. (a) Volatile and inflammable, as, for instance, gasoline or kerosene. (b) Fats and oils. (c) Light organic matter. (d) Light matter the product of chemical reaction, as floating material from gas wastes, etc.

These classifications are of service to indicate simply the general types of material which may be present. The wastes to be handled vary considerably with the industry, and even among plants of the same industry, according to the processes used and the material produced. The prevalent waste differs in the various States. In Indiana, for instance, strawboard wastes are very common, whereas in Ohio creamery and wire mill wastes occur, in Maine the pulp and sulphite waste, and in Illinois the wastes from the packing houses, tanneries, starch works and distilleries are most common. At times canneries give trouble. These are usually found near the agricultural districts.

PROCEDURE IN TAKING UP A PROBLEM

In studying an industry from the standpoint of treatment of the waste, the first essential is to learn the processes carried on and the probable sources and amounts of waste. Seldom does the manufacturer know just how much sewage he is discharging. A thorough inspection of the plant in all its details is of value, for frequently the study of the inside workings reveals many points at which waste can be reduced with comparatively small expenditure of material and labor. No general method of procedure can be stated, as each plant is usually a law unto itself. At times separation of the wastes may be desirable, whereas in other cases, as for instance in tannery work, the effluent from one part of the plant contains chemicals that may be of material value in precipitating material held in suspension in the effluent from another part of the plant. Under those conditions mixing of the wastes is of service. Rain and surface water drains generally should be kept out of the sewer systems receiving waste, in order to avoid at times of rain serious overloading and scouring out of the material which should be retained.

TREATMENT METHODS AVAILABLE

The methods of treatment available are somewhat more varied than for domestic sewage, although for the most part the same general principles apply. The difficulty is, of course, to find the proper constants and loading which can be used to produce results. Owing to the diversity of practice in many plants, the sure way is to try out what can be done with the individual case in question.

Dilution.—With wastes containing no suspended matter, ample dilution frequently suffices. Sometimes this dilution can be furnished artificially from storage reservoirs. Again, it is available in large streams, such as the Mississippi or other rivers with sufficient flow. Where the dilution is not adequate, and velocities are low, the suspended matter in wastes containing such must be reduced in order to avoid deposits in the stream. Screening and sedimentation are available for this purpose.

Screening.—Screening seems eminently suitable for the coarser wastes, such as come from the stockyards, slaughter-houses, beet sugar works, pulp mills, etc., where material slow to digest can be readily removed by a fine mesh screen. The disposal of the screenings when putrescible may, however, be complicated with the problem of avoiding nuisance. Sometimes the material can be dried and burnt. Occasionally it can be turned back into the processes. Directly comparative results available in the packing industry would indicate that considerable material is left over after fine screening, which can be removed by settling. However, the screening removes much which is slow to settle and is a source of scum in sedimentation tanks.

Settling.—Settling should remove practically all the settling suspended matter, the actual per cent. depending on the waste, the period of settling, the type of tank and the velocities used. A doubledeck tank is frequently most suitable where much scum-producing material is present. In extreme cases, fine screening has been proposed as a preliminary treatment to reduce the scum-forming material. With comparatively inert material, the Dortmund type of tank with sloping bottom may prove successful if properly and frequently cleaned. On tannery waste, particularly from the limes, heavy material is present which will quickly settle. In wool pulleries or wool scouring shops much heavy grit is produced which also drops quickly. For such gritty waste a grit chamber design readily cleanable is desirable. Unfortunately, many of the tanks now in operation in tanneries and elsewhere are expensive to clean, as the entire work has to be done by hand on days when the plant is shut down.

Chemical Precipitation.—Chemical precipitation may materially increase the removal of suspended matter by settling, and in some rare cases may be produced by the combination of chemicals already in solution in wastes from the various processes in the plant, particularly in tanneries.

Septic Tanks.—Septic tanks were once widely used in the past, and are used occasionally today, despite their limitations, on creamery, canning and tannery wastes where organic matter slow to decompose needs breaking down. As a rule, however, the septic tank is not regarded favorably on account of liability of nuisance and the larger storage required to hold liquid for many days.

Filtration.—Very frequently further treatment is required to produce an effluent needing but slight if any dilution. In Massachusetts intermittent sand filters have been used freely in experimental work, as well as in actual practice, but of late sprinkling filters have been found helpful, particularly as a preliminary to intermittent sand filtration, in connection with tannery or other wastes high in organic matter, thereby permitting much higher rates of application to the sand filters. In Chicago, on the mixed waste from Packingtown, a sprinkling filter has proved adaptable in handling mixed stock-yards and domestic sewage thoroughly settled. Owing to the possibility of deposits of grease in such a filter, its history is being watched over several years.

Evaporation.—Occasionally a waste is so difficult to handle and contains so much material in solution that evaporation appears to be the only remedy. Although the economy of evaporation is markedly increased by the use of several effects, the process is expensive, particularly for dilute wastes. It has, however, proved practicable in the packing industry for evaporating "tank" water from the rendering tanks which contains matter of value as a fertilizer, and has also been applied in evaporating distillery wastes, as well as in recovering chemicals from industrial processes where they can be used over again to advantage and profit.

SLUDGE

Amount.—As in the treatment of domestic sewage, a sludge problem soon arises, for the quantity of sludge found in industrial waste is frequently much greater than in domestic sewage. The amount varies widely. In the mixed waste tested at the Centre Avenue testing station of the Sanitary District of Chicago the amount of sludge in an Emscher tank was approximately 10 cu. yds. per million gals., as compared with about 1 cu. yd. found at the 39th Street station on domestic sewage. In the tannery tanks with plain sedimentation from 10 to 100 cu. yds. per million gals. are found. However, in the tannery industry the flows are not usually great, so that the total volume of sludge produced in a day is not quite so appalling as the figures might indicate, although large enough.

Treatment.—The treatment of the sludge depends largely on the waste itself. Where there is a large mass of material to be disposed of with little value except for filling, the expense is for transportation to the nearest dump. Frequently with proper treatment on organic wastes, a quick drying sludge may be produced, as for instance by the use of the double-deck type of tank on the mixed packing-house waste. Such sludge may contain some nitrogen, but is not commonly regarded at present as a valuable material. Sludge pressing may reduce the water content. Under certain conditions the sludge itself may prove of value for the recovery of fat, and once the fat is extracted, the dried sludge may serve as a filler for fertilizer. The basic value as a fertilizer from the laboratory standpoint may be doubtful on account of what the chemists call the difficulty of the assimilation of the nitrogen by the soil. A sure test is the actual trial of the sludge in the field.

OXYGEN DEMAND

In testing the strength of industrial waste the sanitary engineer is primarily interested in the oxygen demand, particularly where the stream flow available is limited. This can best be determined by the use of a dilution test or the nitrate test devised by Dr. Lederer. The comparison of strength of sewage by this method is of value, and is impressive even to the layman. In the Sanitary District the domestic sewage at 39th Street has been found to have a bio-chemical oxygen demand averaging 100 to 125 p.p.m., with a consumption of approximately 25 to 30 per cent. in the first twenty-four hours at 20 deg. C. The mixed stock-yards and packing-house wastes average 900 to 1,300 p.p.m., with a consumption of about 20 per cent. in the first twenty-four hours. Tannery wastes vary considerably, ranging from 400 to 1,000 p.p.m., with consumption averaging around 7 per cent. in the first twenty-four hours. The consumption in the first twenty-four hours at 20 deg. C. has a direct bearing on the condition to be met in a stream if twenty-four hours is the interval of time to the critical point. Other time periods may be taken for study, if desired, to meet local conditions.

DESIGN OF WORKS

In the design of works to handle industrial waste, the manufacturer is usually anxious to cut the cost of installation to a minimum, and consequently the most careful designing is required. Where a plant is located in a city in the midst of a built-up region, lack of space is a great handicap. Although willing to employ legal talent, the manufacturer is frequently averse to engaging competent engineering advice. Consequently it sometimes happens that more funds are frittered away in ill-considered experiments than would produce a practical working plant for service, and this phase is occasionally complicated by the eager salesman who urges devices which from their very principle could be ruled out as impractical or insufficient from the start.

Inside any industrial plant, self cleansing sewers are a necessity, with plenty of man-holes for ready inspection. In the tanning industry provision should be made on the floors at all inlets to the sewers to hold back large pieces of material, such as skin and the like, by suitable screens of perforated plates set in the floor over the outlet drains. Some of the most up-to-date factories are equipped with catchbasins under every inlet. The exact efficiency of this is, however, unknown. On lines of sewer the use of fine screens may be desirable to separate out material that is hard to handle and material which might interfere with the proper working of pumps or other machinery.

Settling tanks should be designed for ready cleansing, as hand cleaning is expensive, although still practised in most tanneries. The experience in the Chicago District would indicate that a tank with bottom slopes over 45 deg. and near 30 deg. from the vertical will feed the sludge to the centre of the tank. However, the sludge may become so caked, if cleaning is infrequent, as to be difficult to pump. Compressed air, water or steam introduced at the bottom of the tank just before pumping will break up the sludge and render it easily handled. Wool, leather strips or other foreign material which will tend to clog a small centrifugal should be screened out. Ample sludge drying beds and sludge storage should be provided.

Skimming basins are also useful to hold back grease, or light oils. Grease may occur either in a form which tends to float, or to be held in suspension or to sink. In hot liquids, basins or large surface area are used. These are the reverse of settling basins, in that scum retaining baffles are provided with scant sludge retaining features. Among these are found the skimming basins built to catch oils from the locomotive shops or roundhouses, as well as to catch tar and refuse escaping through the sewers from gas works, and works for the utilization of tar and gas works waste. In many cities there are now municipal requirements in force which require traps to retain gasoline and oils escaping from garages. In Chicago a triple basin is used suitably trapped and baffled for this purpose.

The sanitary engineer today realizes that sewage can be treated either by aerobic or anaerobic methods to arrive eventually at the same stage, the breaking down and transformation of putrescible organic matter. The anaerobic methods attack organic matter vigorously, but are difficult to control and liable to produce serious nuisance. Consequently, the sanitary engineer has endeavored in the treatment of domestic sewage to keep the sewage as fresh as possible throughout the sewers and treatment. In the height of the septic tank vogue the anaerobic decomposition applied too generously disgusted many manufacturers and proved to their minds at least, from the foul liquids and odors produced, that their wastes were incapable of any treatment. However, other methods available today of screening, settling and aerobic treatment should be tried before final opinion is pronounced. It is rather curious that the septic tank should have been discovered in England and there patented, when for years the Chicago River and Bubbly Creek had been operating as a septic tank, probably the largest in the world, yet censured by all who passed by. Consequently, with Bubbly Creek as an example, it is now difficult to see why the same method was followed in the hope of securing results free from nuisance. In any sewage treatment, either industrial or domestic, the greatest possible freedom from odors is desirable, as well as absence of ill-smelling liquids. Hence the suspended matter should be removed as quickly as possible. There may, however, be some wastes in which the use of septic processes is still of service.

In approaching the manufacturer it is unwise to arouse any false hopes as to the possibility of recovering values from the wastes. As a rule the manufacturer feels that little escapes to the sewers of value to him, and promptly forgets that much may escape which is troublesome to the sanitarian.

The municipality has a basic interest in the wastes discharged by industries, even though the domestic sewage be not treated, from the standpoint of sewer maintenance. Consequently, in most cities ordinances will be found regulating the methods of entrance to the sewers, and prescribing catchbasins and other devices suitable to retain settling material which may cause deposits. Oil is also undesirable. Gasoline and other volatile fluids should rigorously be kept out of the sewers. The intelligent interpretation of these ordinances by an engineer familiar with industrial processes and the application of engineering principles materially helps in holding back a great deal of material at its source, and by so doing relieves expensive maintenance of the sewers. Recently in another city paunch manure from packing-houses completely stopped a 24-in. outfall sewer for a distance of 120 ft., flooding the adjoining back yards. This necessitated the removal and rebuilding of the sewer.

SEPARATE VS. MIXED TREATMENT

The question of treatment and whether it is best to treat industrial wastes separately or mixed with domestic sewage is a problem which must be solved for each case. However, the principle seems clear that many wastes which are difficult of treatment alone can be more readily handled when diluted with domestic sewage. In this classification, particularly, are wastes which are sterile at their source and which by dilution with domestic sewage are thoroughly seeded with bacterial life required for self-purification. Wastes slightly acid may be neutralized by the alkalinity of the sewage and seeded thereby. The problem is largely one of economy and expediency for each locality. Occasionally hints can be gained by comparison of methods employed in different industries. For instance, in the mining field a great deal has been accomplished on special devices for the classification and concentration of fine slimes to secure economy in cost and operation. To some other industries these same devices may be applicable.

The foregoing discussion of the engineering features of industrial waste treatment is an abstract by Engineering and Contracting (Chicago), of a paper by Mr. Langdon Pearse, Division Engineer, in charge of the sewage disposal investigation for the Sanitary District of Chicago, delivered at the annual meeting of the Indiana Sanitary and Water Supply Association.

The St. Lawrence Brick Company, Limited, have removed their offices from La Presse Building, to 71 St. James Street, Montreal.

Corrugated Pipe Used Successfully for Culverts

CORRUGATED pure-iron pipe has solved the problem of how to replace failing timber culverts under high embankments on the Western Pacific Railroad without disturbing the fills. The cost of concrete would have been prohibitive, and cast-iron was also out of the question on account of the difficulty of handling of heavy lengths inside the old culverts. The ability of corrugated pipe to accommodate itself to the settling of embankments and to dispense with absolutely rigid foundations was another argument in favor of its use.

During the construction of the road in 1907 a considerable number of timber culverts had been built. The timbers were of 12-in. Douglas fir. The side timbers were laid on top of each other and drift bolted together. Floor sills were laid on 4½-ft. centres. The floor planking was 4 x 12 in. Standard sizes in these culverts were, 3½, 4½ and 5½ ft. square.

During the past year or two it has become evident that many, if not all, of these would soon require replacement with more permanent material. As many were installed under very deep fills, to accomplish this with concrete or cast-iron would have been very expensive. Corrugated pure-iron pipe was decided upon because it was found practicable to install this in the nestable form inside the wooden culverts and tamp the filling effectively around the pipe. This method showed a great saving over any form of construction which involved completely excavating the old work, and, from the behavior of the first installations of the kind, seemed likely to give very good service.

For this purpose the nestable Armco (American Ingot) iron culverts come in semi-circular sections 2 ft. in length, provided with a special connector for drawing half sections together, which, under these circumstances, must of course be operated from the inside of the pipe. For these installations the fill is not disturbed, but the floor of the old timber culvert is removed.

Where the timber culvert has been crushed by the weight of fill, tunnelling becomes necessary. Little lagging is required, 2 x 8-in. head boards and 4 x 4-in. uprights being used instead. As the culvert is installed, the uprights are removed and the head boards allowed to remain in place. The 2-ft. sections are assembled inside the timber culvert and the backfilling and tamping accomplished as each section is put in place. This is considered an extremely important feature of the installation, and the practicability of thorough backfilling and tamping in this way was the principal reason for the choice of this form of culvert. The minimum backfill is 6 ins. on the sides and 12 ins. on the top.

The culverts are 36, 48 and 60 ins. in diameter, these being installed inside the timber waterways of square dimensions, 6 ins. greater in each case. The material is No. 10 gauge. The fills vary in depth from 8 to 100 ft. or more.

Careful experiments made with this type of nestable culvert indicate that it will carry approximately 90 per cent. of the load of a full-circle continuous riveted corrugated pipe; and the experience of the Western Pacific is that in the sizes and gauge mentioned and with due care in installation it will give good service under rather severe conditions.

With the timber culvert cleaned out in advance, four men will lay this form of nestable pipe, per day, approximately as follows: 36-in., 40 to 42 ft.; 48-in., 50 ft.; 60-in., 30 to 32 ft.

Where the fills are not more than 8 ft. deep it is found economical to excavate from the top and place full-circle, continuous riveted Armco corrugated pipe. In these cases the top and floor of the timber culvert are removed but the side walls are allowed to remain. The pipe is installed in sections from 8 to 12 ft. in length. The diameters employed are 18, 24, 30, 36 and 48 in., these being of 10-gauge material. The weight of these sections will not exceed 1,000 lbs., even in the largest sizes. The sections are equipped with a convenient lug coupler for making the connections. These pipes are also carefully backfilled and tamped, this important part of the work being easily accomplished in the open ditch.

For both types of corrugated culvert, head walls are made of stone laid in cement, precautions being taken to prevent water getting under or around the sides of the pipe.

Approximately 8,000 ft. of this corrugated pipe have been used since October 1, 1914, for the replacement of these timber culverts. All of these installations are entirely satisfactory.—Engineering Record.

Architectural Acoustics

IN order to determine the acoustic properties of a building it is no longer necessary to wait until the auditorium is finished and then endeavor to ascertain whether it is good or ill, says Dr. Wallace C. Sabine, Dean of Graduate School of Applied Science of Harvard University, in an article which appeared in the Journal of the Franklin Institute. While the factors of the acoustic problems in an auditorium at all complicated, are themselves complicated, nevertheless they are capable of exact solution or at least of a solution as accurate as are the architect's plans in actual construction. This conclusion is given as the result of experiments extending over a period of ten years and begun in some of the buildings at Harvard.

The question of reverberation of sound was first studied. The principal point there is the absorption of the sound, that is, its transformation into another form of energy. It was found that cushions placed in the seats materially diminished the reverbation and further experiments in absorption showed that the audience itself and heavy hangings three or four inches from the wall were the best absorbers of sound. It was discovered that wood sheathing was a better absorber than plaster, glass or brick.

While materials are the principal feature in reverberation, faults in which can consequently be corrected with comparative ease in an auditorium already built, the shape of the room itself is the best factor in interference—the conflict in sound waves reflected from projecting surfaces, which sometimes continue a sound unduly, sometimes make an echo and sometimes either directly conflict or directly augment each other so as to double or annihilate a sound. Hence the so-called "loud regions" or "deaf regions" in an auditorium. From the experiments, experts in acoustics can now determine by an inspection of the plans of an auditorium whether or not it will be possible to hear well in it, and if not just what should be done to improve it.

Owing to the increasing cost of timber for coach building, the possibility of constructing passenger stock of steel is being considered by the authorities of the Union of South Africa railays, and the chief mechanical engineer has been authorized to order two trains of steel coaches for trial.

Construction Designed to Reduce the Cost of Brick Roads

BRICK laid on a very thin reinforced concrete base is the construction proposed by Professor James S. Tucker, Director School of Civil Engineering, University of Oklahoma, to reduce the cost of brick road construction. The full discussion of his plan is given in a paper presented recently to the Iowa State Engineering Society, and abstracted by Engineering and Contracting.

A large portion of the paper by Prof. Tucker is devoted to a proof of the fibrous structure of paving brick, and to a discussion of the advantages of placing the brick in pavement so that wear is across the fibre, with a plea for a soft joint filler instead of grout filler. The paper then presents the facts and reasoning supporting the proposed new construction, and these we give here somewhat condensed from the original.

Results of Tests

Late in 1912 there were made in the engineering laboratories at the University of Oklahoma a series of tests to indicate the behavior of concrete pavement foundations. Concrete slabs, representing a section of the pavement 1 ft. wide of various thickness when suitably aged were placed in the testing machine and supported on knife-edges 27 ins. apart and the load applied directly to the centre of the slab. The average centre concentrated load borne by 6-in. plain slabs at twelve days, was 1,200 lbs.; by 5-in. plain slabs at eleven days, 1,125 lbs.; by the 4-in. plain, at ten days, 630 lbs. A 2-in. slab, reinforced with wire fencing in the middle, averaged 460 lbs. at ten days or four-fifths as much as the 4-in. plain; 3-in. slabs, reinforced near the bottom, gave 1,180 lbs. in ten days; or the same as the 5-in. slab and nearly as much as the 6-in. Four-inch slabs, also reinforced near the bottom, gave 1,150 lbs. in ten days. One 4-in. slab with three wires at age of 27 months gave the remarkable test of 3,000 lbs.

The reinforcement used in every case was ordinary commercial rectangular mesh hog-fencing of galvanized wire, costing from 3 to 5 cents per square yard in place in the street foundation. The slabs tested had either three or four longitudinal wires, just as it happened to come from the top or bottom of the fencing. The meshes ranged between 5 x 6½ and 3½ x 6½ inches. The top of the fencing had wires of ⅛-in. diameter, while the balance were 9/16 in. diameter, and the transverse knotted stay wires were 7/64-in. In none of these cases did the wires break except in the 27-month test, but as the ends of the strands were not even turned up, or hooked, and as in numerous specimens the wires were embedded only about ¾ in. from the bottom of the slab, they frequently pulled loose and slipped as the upper part of the slab crushed under the load. The concrete was of the most ordinary sort, made in a hand mixer, proportion 1:4:5, with ¾-in. limestone, and a coarse and a fine grade of sand in equal parts. The slabs were aged in an open field between October 28 and November 12, for the most part.

The significance of these tests appears when we consider the cash value of the facts learned. Wherever there is need for a 6-in. base, one 3 inches thick with 5 cents' worth of reinforcement will do equally as well. The cash saving is notable, since the concrete will cost from 15 to 20 cents per square yard per inch of thickness. Hence this simple use of hog-fencing means from 40 to 55 cents per square yard of pavement actually saved, or 25 per cent. saving on a pavement costing from $1.60 to $2.00. This is a saving of $1,000 upon about 2,000 sq, yds. of pavement, and a small job of paving usually runs to several times this amount. Nor is this all. Having seen that we can do with 3 inches of concrete all that is now done with 6 inches, the next obvious question is: Is a pavement base of even that strength ever needed?

It will be observed that the loads of 1,500 lbs. obtained with the 4-in. slab represent a wagon wheel carrying one-fourth of a three-ton load. This is probably about twice as great an intensity as would occur for a ten-ton road roller, and somewhat greater than under a large traction engine. Note, however, that the slab tested had the following very great handicaps: first, the load was applied at the centre of a clear unsupported span of 27 inches. Second, the slab was discontinuous in both directions, and hence could receive no support from adjacent portions of the concrete. Third, this discontinuity, of lack of anchorage, was of vital importance to the reinforcement, since only in the one case of the block aged 27 months did the wires break. That is, the capacity of the wires missed development by from 50 to 80 per cent.

The most vital variation between this experiment and practice, however, lies in the unsupported span tested. We certainly need not assume that we must design to meet this non-supported condition in practice. Nor need we figure safe loads without taking into account the supporting power of the sub-grade. Every engineering text on foundations suggests that almost any dry soil can be safely relied upon to carry two tons per square foot, if kept free of excess moisture. The soil will be very bad indeed which will not carry one ton per square foot, and for particularly good ones it may run to eight or ten tons. Taking two tons as a reasonable figure for soil which is to have a tight roof, and which may be assumed to have received the attention of a steam roller, this would give a supporting capacity of about 30 lbs. per square inch, running up to six or eight times that with the better soils.

If we consider a 3 x 8-in. brick as receiving a wheel-load of 1,500 lbs., and as resting on a 1-inch sand cushion carried by concrete 3 inches thick, then taking the usual assumed divergence of load lines as 45 deg., this wheel load is distributed over 170 sq. ins. of earth surface, giving an intensity of 9 lbs. per square inch. Since we are counting upon a 30-lb. soil as a minimum, which figure already includes an ample factor of safety, it is evident that the soil can not be overstressed, even though we consider the area of concrete loaded as a separate flagstone, and not part of a continuous slab, which it certainly will be.

Without assuming that our foundation has any particular tensile strength, therefore, we are forced to conclude that a soil area of 50 sq. ins. would carry the 1,500-lb. wheel load with perfect safety, while in fact the area receiving the load is over three times as great as this. This, it is thought, will serve as an ample allowance for the case where the load is applied to the joint between two bricks where there is a non-rigid joint filler.

We thus find ourselves to have reasoned around to our starting point, the contention of MacAdam that a well-drained and compacted road surface would bear any wheel loads that could be put upon it. We see that if a space 4 inches long under our 12-in. wide test-slab had been occupied by soil of the supporting capacity named, instead of the slab having a clear unsupported span, then there would have been no need of reinforcement in it.

Pursuing the logic still further, it appears that the thickness of the slab is of little import, since it is the subgrade which must really and eventually carry the load in any case. As the thinner slabs deflected about ¾ in. without falling, it is seen that the soil area called into support will greatly exceed what is needed to bear any load coming upon the pavement surface.

This reasoning indicates that a 2-in. slab with the wire in the middle would be amply strong, and would effect a still further saving of money over that already indicated. The speaker is not prepared to recommend this thickness, however, unless the paving specifications are otherwise radically amended, notably in the preparation of the subgrade. He is convinced, however, that an average expenditure of 3 or 4 cents per square yard in excess of the present practice devoted to watering, raking, and continued rolling of the subgrade would render the 2-in. base entirely feasible. He is also convinced that such rolling and painstaking treatment of the subgrade would surpass in effective supporting power and increase pavement stability more than the introduction of four extra inches of concrete foundation as now commonly practised, while the cost reduction might then amount to 30 per cent. of the total.

It may here be claimed that this paper first makes a great argument for wire reinforcement, and then shows that it is unnecessary. The practical difficulty of getting a uniform and homogeneous subgrade is freely admitted, even with the care and effort here asked for. This is exactly where the reinforcement comes in,—to render the pavement stable and secure from disturbance by reason of such defects in its support, for if these thin slabs with the trifling reinforcement used, will under all the handicaps herein indicated virtually carry any possible loads over clear spans of 2 ft., it is certainly rational to suppose that they will carry and distribute the loads properly when resting on almost any soil short of liquid mud. This we certainly need not provide for, nor need we regard a general settlement in any pavement as fatally defective.

Having now considered the pavement foundation at length, let us turn back and see what bearing, if any, this discussion has upon joint fillers, and its possible relation to the shape and size of the brick. To the speaker there is a most profound and significant relationship between all these factors. It is thought that those who have contended most strongly for the rigid cement grout filler do so through failure to recognize fully the meaning of the MacAdam principle. They have seemed to consider that the brick wearing surface must not only furnish a strong wearing surface which would then resist the abrasion of traffic, and that it must also perform all the functions of the foundation as well. As already suggested, if temperature stresses did not enter into the problem results under this theory might still be fairly satisfactory. But since temperature strains are bound to occur, and are likely to cause cracks and fractures, why not guard against them by using ample expansion joints around each brick, and use bituminous filler. If the foundation and subgrade have been planned and executed to develop their legitimate functions then there is no need for the wearing surface to attempt to include that also, and perfect stability of the wearing surface is insured not by attempting to make it immovable and unbreakable in itself but by furnishing it with a strong immovable and unbreakable support.

It is at once evident that the single quality which has given brick such a prominent place as a paving material is its wonderful resistance to abrasion. Even where paving has been done in violation of all the principles herein studied no one has yet seen a brick pavement really worn out. It follows therefore that with an adequate support provided, and temperature stresses relieved as above outlined it will then be preeminently sound engineering design to lessen the thickness of the wear resisting surface. The speaker believes that 2 or 2¼-in. paving brick laid flat with a bituminous filler, upon 1-in. or less of sand supported by a 2-in. reinforced foundation, all borne upon a carefully, but cheaply, prepared subgrade, represents the distinctly modern type of economical pavement construction for every sort of traffic except the most intense steel-shod traffic when bricks of the usual thickness would be economical. Also with subgrades of special difficulty as to drainage and known instability of soil an extra inch might be added in the foundation.

Watertightness of Gravel Concrete*

ALTHOUGH the specimens of concrete examined varied in proportions up to 1:9, most of them were so impervious that no visible evidence of flow appeared. For most purposes such concrete can be considered watertight. By grading the sand and gravel in accordance with Fuller's curve it was possible to obtain practically watertight concrete of 1:9 proportions under pressures less than 40 lbs. per sq. in.

In the proportioning of the materials, volumetric analysis, coupled with a determination of the density and air voids, yields valuable information concerning the best proportions of sand and gravel for a given proportion of cement. If proportions must be selected arbitrarily a 1:1½:3 mixture, by volume, is very impervious.

The use of the proper amount of water necessary to produce a medium consistency is one of the most important conditions in securing impervious concrete, especially when poor mixtures are used. On the other hand, a wet consistency does not materially affect the imperviousness of rich mixtures, such as 1:1½:3 concrete.

No process in the making of impervious concrete is of more importance than curing. The results of these tests clearly demonstrate that premature drying destroys the imperviousness of 1:9 mixtures, seriously impairs that of the 1:2:4 mitures and somewhat diminishes that of 1:1½:3 mixtures. For thin sections, not over six or eight inches thick, the curing conditions should be such that a lean concrete will be kept damp for a period of one month and a rich concrete for at least two weeks. Even after a month of proper curing, the complete desiccation of a poor concrete produces an increase in permeability, but the effect on a rich mixture is not marked. In these tests the imperviousness of the concrete increased rapidly with the age of the specimens for the first month; thereafter the change was not marked.

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* Notes from a paper by Professor M. O. Withey, before the Western Society of Engineers, describing the results of a series of tests made at the University of Wisconsin.

Corrosion of Naked Steel in Sea Water

THE perishable nature of unprotected steel in maritime structures is emphasised in a paper read to the Institution of Civil Engineers by Mr. S. H. Ellis, M. Inst. C.E. Referring to three steel wharves constructed during 1907-9 in Hong-Kong Harbour, the author says that in 1906, examination was made of some steel-joint piles which had been in place for about four years, and they were found to be corroded in a curious and rather alarming manner.

The piles were coated with barnacles and other shell-fish, and with a dense vegetable growth, particularly from near the surface of the water to 15 ft. or so below it. It had been an accepted theory that this growth protected the metal and prevented rusting. On scraping away the growth from a pile of the wharf examined, however, it was found that a large number of pits had formed in the surface of the steel, varying up to 1¼ ins. in diameter and ⅜-in. deep. They were full of a black powder, which also occurred in a thin layer on the surface of the unpitted steel and was found to be sulphide of iron (FeS). Apparently, some shell-fish or marine growth attached to the piles produces sulphuretted hydrogen when dead and decaying; this gas attacks the metal, with accentuated action in certain spots, producing the pits described; and when once the process is started, the deposit of sulphide facours more rapid erosion beneath it.

The author examined also some steel piles, which had been in place only 3 or 4 years, and estimated that 10 per cent. of the metal was eaten away in some sections, chiefly in the form of pitting.

As a result of his inspection the author recommended that the piles and lower bracing of the main wharf should be encased in 1:2:4 cement concrete; and it was eventualy decided to encase the whole of this structure, leaving the other wharves with bare steel, which was painted with anti-corrosive composition on erection.

The amount of polish which can be given to the surface of concrete depends upon the density of the mixture and the nature of the aggregate used. The process of polishing as described in Concrete-Cement Age, by Mr. C. W. Boynton, is as follows:—After the surface has been smoothed down on a rubbing bed, or by the use of rotary rubbing stones, as applied in terrazzo floor work, the procedure is somewhat similar to that used in polishing granite or marble. The aggregate exposed on the surface by the rubbing process takes the polish, the appearance of the surface being dependent upon the percentage of aggregate exposed.

A novel form of electric vehicle is in use in the Panama-Pacific Exhibition in the shape of a two-seated miniature car with basketwork body, capable of a speed of three miles per hour, to take the place of the wheeled chairs which have been a feature of many exhibitions. The "Electriquette," as it is called, has battery power sufficient for eight hours' running.

Removing Stains from Stonework

IN the first place, it cannot be insisted upon too strongly that no stone now accepted as a standard in the market contains within itself the elements of staining or discoloration. It may change its color somewhat in weathering, but this will be in the way of a mellowing of tone, and will give no unsightly blotches. This is proved by the natural exposure of the rock in the quarry. Where there is staining in the walls of a building, it can safely be set down to faults in the setting, or to some cause extraneous to the stone itself.

The most prolific source of trouble, says a writer in Stone, is, of course, the cement that is used in setting the stone. Ordinary Portland cement will badly stain almost any stone. Various so-called "non-staining cements" are widely heralded, but it is the universal experience of stonemen that little dependence can be placed on these.

In the old days, before cement was so widely used, architects rarely had to complain of staining. There are thousands of buildings that have stood for half a century or more that show only the kindly mellowing of time, save for the effect of smoke and dust incidental to city life.

Architects will specify very particularly that stone be set in cement mortar and think that they guard against all trouble if they require the back and sides of the stone to be coated with waterproof paint. Undoubtedly a good paint is much protection, but the difficulty is to coat the beds and joints of each stone clear to the face. A narrow strip left unpainted will permit the carrying of the discolorating moisture from the cement to the face of the stone by capillarity.

All of this trouble could be avoided if the architects would only insist that the stone be set entirely in lime mortar, made in the following proportions: one part lime and three parts sand. The lime to be thoroughly slaked and the sand well tempered; all mortar to lie in the pile at least twenty-four hours before using; all sand to be clean, coarse, and free from loam. If the most delicate stone is set in mortar as above, and the back of the stone plastered with the same mortar, it positively will not stain.

There is another way in which stone may be stained—by the drippings from concrete floors or roofs. In such cases the discoloring moisture runs down the face of the stone, and no painting of the back or beds can afford any protection. The utmost care in superintending the construction is the only safeguard from this disfigurement.

Cement stains cannot be eradicated by any wash or other treatment. Fortunately, they are apt to bleach out in time under the influence of the sun and the weather. The architect and the owner alike are naturally greatly exercised when cement stains appear, and try to seek some immediate remedy. The only thing to do is to have patience and wait for the natural bleaching, which may take weeks or even months.

The stone setter, anxious to leave a building in spick and span condition, may suggest that it be washed down with muriatic acid. This should never be permitted. The acid may take out some of the stains for the moment, but it burns the surface and eventually will discolor even those portions that escaped the original staining.

There was a time when scrubbing with wire brushes was permitted, but this has generally been discarded, since its bad effects have been recognized.

It is impossible to use wire brushes without leaving a coating of iron on the surface of the stone, and this is bound to leave a worse stain than it corrects.

The sand blast is sometimes employed, but generally for old buildings that have become discolored from smoke and soot. This method should always be discouraged. The sand strikes the stone with a tremendous impact. It destroys the "skin" which forms on the surface of the stone by deposition of mineral ingredients on the evaporation of the interstitial water. It also stuns the grains or crystals of the stone and tends to hasten the weathering.

The very best treatment of stone to remove smoke, soot, dirt, mortar, etc., is a simple washing. A recipe that is recommended by stonemen of the widest experience is as follows: prepare a wash of soft water and about one and a half bars of common laundry soap. Boil until the soap has been thoroughly dissolved. Add a fine, clean, gritty sand (white preferred) and mix to about the consistency of putty. While mixing add about five tablespoonfuls of ammonia to a bucket of water. With this preparation scrub the surface with a stiff scrubbing brush, wash down with a stream of water from a hose, and then go over it again with a scrubbing brush.

While any building may need a cleaning, a great deal of the staining could be avoided if more care were taken. While speaking of the evil effects from cement and the dripping of dirty water, there are other things to be guarded against. The rust from improperly protected iron or steel and the verdigris from copper or bronze sheathing have disfigured many a fine structure. The writer knows of one very costly building where the oil-saturated exhaust steam from hoisting engines was discharged directly against the facade. What wonder if this is permanently stained? Doubtless the architect is speculating as to the cause of the discoloration, and it inclined to blame the stone.

Brick Pavement Details

THE subject of brick pavements, with special reference to those laid in Ohio, was treated of by John Laylin, division engineer of the Ohio Highway Department, in a paper before the American Road Builders' Association. He described the standard method of building brick pavements (practically that recommended by the National Paving Brick Manufacturers' Association) and in conclusion described briefly a few details of certain roads in his state. A stretch of the Cleveland-Buffalo highway in Lake County, 2½ miles long has a brick surface 18 feet wide curbed on each side, and with a 24-inch concrete gutter having a 2½-inch concave surface. These gutters collect the water from both the pavement and the lawns and conduct this to catch basins connected with a system of underground drains. The lawns slope back from the gutters and the park-like effect is very pleasing. Two streets in Norwalk, Ohio, have been laid on natural bed foundations and edged with vitrified curbs. These curbs were made on a regular paving brick machine with three out of four of the cutting wires removed, thus making a block that when burned was 4 x 8½ x 51½ inches. These blocks were set with the 8½-inch dimension vertical and bedded in gravel or crushed limestone. Portland cement filler was used in the pavement. The work has been in place less than two years, but looks like good cheap pavement construction. He recommends concrete foundation, however, where traffic is heavy.

Personal Mention

Mr. F. L. Fellowes, City Engineer of Vancouver, has returned to Vancouver from Calgary after having been called east by the serious illness of his brother.

Mr. Emmett Kelly, a son of Mr. Thomas Kelly, of the contracting firm of Thomas Kelly & Sons, Winnipeg, died suddenly at Atlantic City, N.J., a few days ago.

Mr. F. W. W. Doane, City Engineer of Halifax, in a letter to hand last week, informs us that he is on outpost duty with the 63rd Regiment at the mouth of the Halifax harbor.

Col. H. N. Ruttan, formerly City Engineer, and later Consulting Engineer to the city of Winnipeg, is now engaged exclusively on military work. He is stationed at the Fort Osborne Barracks, Winnipeg.

Mr. W. Blaine Redfern, Town Engineer of Steelton, Ont., graduated with honors from the School of Practical Science, Toronto, in 1908. For three years he was employed by Messrs. Chipman and Power on sewerage and waterworks installations at Orillia, Dunnville and Steelton, Ont., at Weyburn, Sask., and Dauphin, Man. He became Town Engineer of Steelton three years ago. During his term of office he has had a wide experience in all the various branches of constructional activity which devolves upon the engineer in a growing municipality. Steelton is now a thriving town of 5,500 inhabitants. In it are situated the large steel works of the Lake Superior Corporation. It has extensive sewerage waterworks and electric light systems, as well as permanent pavements and concrete sidewalks. Its growth in the last few years has been rapid, and with cheap power and good factory sites it presents good opportunity for further industrial expansion.

Mr. W. Blaine Redfern.

Capt. Gault McCombe, of the contracting firm of Collier, Newton, McCombe, Limited, Montreal, was wounded in the fighting at Langemarck. He is a captain in the 14th Battalion. Private Peter Lyall, Jr., of the 14th Battalion, who was wounded in the head, neck and arm, is the son of Mr. William Lyall, of the Peter Lyall and Sons Construction Company, Limited, Montreal. Private Lyall, who is 21 years of age, was studying at Boston when the war broke out. He sailed from New York and joined the First Contingent at Salisbury Plains. He is now in hospital at Tunbridge Wells, Eng.

Mr. Percy A. Wright has been appointed Town Engineer of Fort Frances, at a salary of $160 a month, the engagement being for six months only.

Mr. H. H. Vaughan, Assistant to the Vice-President, Canadian Pacific Railway, in charge of the Locomotive and Car Department, has resigned to take charge of a manufacturing enterprise. He will be succeeded by Mr. William E. Woodhouse, Superintendent of Motive Power and Car Department of the Eastern Lines of the System, with headquarters in Montreal. Mr. D. T. Main, who has been in charge of the Mechanical Department at Toronto, will succeed Mr. Woodhouse.

Mr. John Kennedy, known in Montreal as "the man who made the Montreal harbor," has just celebrated the fortieth anniversary of his connection with the Montreal Harbor Commission. Mr. Kennedy is now Consulting Engineer to the Commission. He resigned as Chief Engineer about eight years ago owing to failing sight. In addition to his duties with the Harbor Commission, he has carried out much important consulting work—notably a one-million-dollar pier for the Intercolonial Railway Terminals at Halifax. He has been retained many times by the Dominion Government. Mr. Kennedy, who was born at Prescott, Ont., is now in his seventy-seventh year, and it is just forty years since he went to Montreal as Chief Engineer of the Harbor Commission. Previously he had been Chief Engineer of the Great Western Railway of Canada, with headquarters at Hamilton.

Mainly Constructional

East and West From Coast to Coast

Sixteen men from the office of Messrs. Ross & Macdonald, architects, Montreal, have joined the Canadian contingents.

Edmund G. Cullen, dealer in builders' supplies and contractors' equipment, Vancouver, has assigned. The assignee is Ralph Donoghue, 509 Richards Street, Vancouver.

Messrs. R. S. and W. S. Lea, Consulting Engineers, Montreal, have been retained to report on plans prepared for sewerage and water supply systems for Bathurst, N.B.

An interesting paper on "Protective Coatings for Structural Steel" was read last week by Mr. George Henderson before the members of the Nova Scotia Society of Engineers.

Messrs. Patterson, Chandler & Stephen, Limited, stone merchants, marble workers and quarry men, have obtained a charter. The head office is at Vancouver, and the capital of the company is $25,000.

Exterior work is progressing rapidly on the new school which the Toronto Board of Education are erecting on Givens Street, at a cost of $165,000. The building, which is of brick construction, will contain thirty rooms.

A new company, whose head office will be at Ottawa, is the White Marble Company of Canada, Limited, which is capitalized at $150,000. The incorporators include Mr. T. A. Beament and Mr. A. H. Armstrong, both of Ottawa.

The Simplex Asphalt Paving Company, Limited, Montreal, has been incorporated with a capital of $100,000. The incorporators include Messrs. F. H. Markey, W. W. Skinner, W. G. Pugsley, G. G. Hyde, and R. C. Grant, all of Montreal.

Three aviation sheds are under construction at Toronto. The work is being carried out by the owner, Captain E. L. Janney. The building now being erected is 80 x 50 ft. in dimensions, of frame construction, with galvanized iron sides and roof.

Some of the smaller municipalities in the eastern provinces are doing their proportionate share of construction. Last week we noticed that St. Michel de Lavel, Que., awarded a contract for concrete pavement and asphalt sidewalks running into $130,000.

Mr. H. S. Van Scoyoc, Chief Engineer to the Toronto-Hamilton Highway Commission, is urging that all traffic between the two cities be diverted from the Lake Shore Road to the Dundas and middle roads, in order that constructional operations may proceed unhampered. Excavation work is in progress, with six gangs of men engaged at different points. Contracts have been let for material, and the force will be augmented shortly. Five hundred men are now employed. The total excavation to date is estimated at 58,000 cubic yards. The sum expended on labor in the winter months exceeded $40,000.

Manitoba Engines, Limited, a Brandon concern, have just obtained a contract for 15,000 shells, which represents an expenditure of $70,000. The firm is taking enterprising measures to cope with the business, and has installed new machinery to the value of over $10,000. The contract must be completed within six months.

The interior work is now in progress on the eleven-storey office building which the Excelsior Life Association are erecting on Adelaide Street, Toronto, at a cost of $500,000. The building, which is of terra-cotta and brick construction, will be described in an early issue of The Contract Record. The architect is Mr. E. J. Lennox, and the general contractors are the P. Lyall and Sons Construction Company.

As an instance of the activity brought about by war contracts, mention may be made of what is being done at the Record Foundry, Moncton, N.B. This concern is installing new machinery to the value of $40,000, and is making arrangements to double its staff in order to cope with the new business in hand and in prospect.

Mr. A. R. Wetmore, Chief Engineer of the Public Works Department of New Brunswick, paid a visit to St. John recently for the purpose of inspecting the suspension bridge work and making arrangements to carry it forward to completion as early as possible. The contractors for the substructure are the McVey Company of St, Stephen, while the Dominion Bridge Company have the contract for the superstructure.

The Alaska Railroad Commission have awarded to The Browning Company, Cleveland, a $6,000 contract for a locomotive crane. The company have shipped to Wheeling, W. Va., a twenty-ton locomotive crane to be used in Ohio River work. To the Panama Canal Commission they have sent a railroad pile-driver, which makes the third of its kind purchased at a cost of $14,000 each. They have furnished twenty-eight such cranes for use in Panama operations.

As one of the results of the orders for shells placed by the Government with Vancouver engineering firms, it is probable that The Heaps Engineering Company will be reorganized and resume active operations. The intimation was given in the Supreme Court last week when an application, which had been pending for some time by a creditor asking for the winding up of the company, came up for hearing. The company is now undergoing re-organization with every hope of success.

From New Westminster, B.C., comes word that the last pile in the North Arm jetty, under construction by The Marsh Hutton Powers Construction Company for the Dominion Government, was driven last week by the Fraser River Pile Driving Company, who had the piling contract on this undertaking. Another month will see the completion of the brush mattressing, which goes out further than the piling, while the rock facing, it is anticipated, will be finished in six weeks. Remarkable time has been made, partly owing to the unusually good weather which has been experienced during practically the entire time it was under way. The jetty, which is two miles long, was commenced in May last year, and under the present schedule it will be finished completely by the middle of June, or little more than thirteen months. Dredging is proceeding rapidly, but this will take probably another year to finish, as it was not started until six months after the building of the jetty began. The final completion of the undertaking will be of inestimable benefit to the North Arm, providing a navigable channel for vessels of considerable draught.

The end of this season will see the completion of $600,000 worth of work on good roads in York County, Ont., according to Mr. George S. Henry, at the meeting of the County Board of Highway Commissioners last week. Already the sum of $480,000 has been expended on the county highways since the inception of the work about three years ago. This year's programme, amounting to $120,000, will bring it up to the total of $600,000, the city, county and province each bearing an equal share of the cost. It was announced that seventy miles of the one hundred and fifteen miles of road in the county system had been rebuilt, and that another twenty-five miles was included in the recommendations of Mr. E. A. James for the year. Ten gangs of men will commence work shortly in various parts of the county. A start will probably be made on the reconstruction of Main Street, Weston, where one and three-quarter miles of new highway will be laid. Improvements will be effected on the following roads this season: Yonge Street, Markham, Kennedy, Don Mills, Lake Shore, Dundas, Weston, Malton, Vaughan and Kingston Roads.

The new international bridge spanning the St. John River between St. Leonards, N.B., and Van Buren, Maine, was opened on May 1st. The opening of the bridge is of great importance to the residents of New Brunswick and a portion of Quebec, as it forms the connecting link between the International branch of the Intercolonial Railway, the Canada and the Bangor and Aroostook Railway in Maine, thus giving direct connection between these districts for the first time. At the point where the bridge is built the St. John River is 970 feet wide and the bridge consists of five single track spans of 160 feet each, supported on the concrete tbuaments and four concrete piers. The bridge is of cantilever construction. A notable feature of the construction work is the rapidity of the completion, only seven and a half months having elapsed from start to finish. The principal contractors were Cyr Brothers, Waterville, for substructure; Dominion Bridge Company, Montreal, superstructure; Hill & Hammond, Woodstock, roadbed, tracklaying, etc., and the Central Railway Signal Company of Canada for the interlocking signals. Mr. W. J. Wilgus, of New York, was the consulting engineer, and Mr. T. A. Lang the resident engineer.

The Quebec Streams Commission, Montreal, have asked for tenders for the construction of a concrete storage dam on the St. Maurice River, 2½ miles above La Loutre rapids and 14 miles above the mouth of the Wabano River. The plans were prepared by Mr. J. W. Thurso, Mr. E. Wegmann, of New York, being called in as consulting engineer, and on his advice a plain gravity dam was adopted. Bearing in mind that the amount of water to be held back by this dam, 160,000,000 cubic feet of water, is just twice as great as the amount stored by the enlarged Assuan dam, which at present forms the largest reservoir in existence, and that the failure of this dam might mean a tremendous damage to the industries located along the St. Maurice river below this storage, besides causing probably a considerable loss of lofe, both Mr. Wegmann and Mr. Thurso agreed that a type of dam be chosen that has been thoroughly tested by many years of practical experience. The dam is to be 1,720 feet long, following a broken line formed of four straight lines intersecting at obtuse angles, with a measuring weir, made of reinforced concrete, 375 feet in length, with its abutments and wing walls. It was originally intended to erect a power house, but it has now been decided to omit this, and if necessary later to develop power at a fall lower down the St. Maurice River. Ten gates each 12 ft. high by 7 ft. 6 in. wide, capable of discharging 18,000 cubic feet of water per second, are to be placed in the dam, the gates to be operated by hand power. The spillway will be 865 feet and is extended to a log sluice.

The Tuec Stationary Cleaner

From Mr. James J. Martindale, Toronto, we have received an interesting illustrated booklet descriptive of the Tuec stationary cleaner. The strong points of the Tuec are enumerated as follows:

1. Simplicity—the greatest of engineering virtues.
2. The large volume of air handled at a vacuum—seemingly sufficient for all needs.
3. The elimination of all intermediate gearing, permitting of the direct connection of the motor and the fan.
4. The quietness of operation, due to the true rotary motion and absence of all reciprocating parts.
5. The compactness of the plant unit, necessitating a minimum of floor space and head room.
6. The fewness of the number of bearings requiring attention and the perfect disposition of the bearings for sustaining the loads to which they are subjected.
7. No metal surfaces in sliding contact—therefore no chance for cutting and wear.
8. The general excellence of the workmanship entering into the component parts of the machine.

Eager, Coombes & Company, Limited, is the new name of an old established Halifax builders' supply firm formerly known as The General Contractors' Supply Company. Both Mr. F. S. Coombes and Mr. R. F. Eager, the principals, have wide business connections, and represent some of the best Canadian and American firms in eastern Canada.

From the Metropolitan Paving Brick Company, Canton, Ohio, we have received a copy of the firm's latest descriptive catalogue. This is an informative, well illustrated publication which cannot fail to be of interest to municipal engineers and contractors. The manufacturing processes of Metropolitan paving brick are detailed carefully from the shalebed to the road-bed. The manufacturers have a strong point in the fact that the United States Government specifications use their product as an accepted standard by which the quality of paving brick is judged.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Belleville, One.
Tenders will be received until 5 p.m., May 13th, by A. C. McFee, Chairman of the Public Works Committee, for the construction of sewers on Coleman, West Moira, West Bridge and Catharine Streets. Plans and specifications at office of Engineer J. W. Evans.

Brockville, Ont.
Prices are now being received by Engineer G. H. Dryson, Victoria Hall, on a steel intake pipe to extend 800 feet into the river.

Cornwall Township, Ont.
Tenders on the construction of a drain will be received until June 7th by John Mullin, Mille Roches, Clerk to Township Council. Estimated cost, $9,000.

Fernie, B.C.
The Town Council have started work by day labor on the construction of crushed rock roads. Approximate cost, $5,000. Clerk, A. J. Moffatt, Box 757.

Glencoe, Ont.
The Town Council contemplate laying cement sidewalks on a number of streets and repairing others. Clerk, George Wilson.

Hull, Que.
The Hull Electric Railway Company, Main Street, are about to lay macadam paving on various streets by day labor.

By-laws have been passed providing for the construction of sidewalks and pavements at an estimated cost of $60,000, and extensions to the waterworks system at a cost of $200,000. Waterworks extensions to include an eight million gallon turbine pump and the construction of an aqueduct. Engineer, J. A. Laforest.

Lachine, Que.
Sewers are being laid in the Summerlea district under the supervision of the City Engineer, for the Marcil Trust Company, 180 St. James Street, Montreal.

Leamington, Ont.
The Town Council contemplate laying an 8-inch watermain on Erie Street and making other extensions. Clerk, R. M. Selkirk.

McKillop Township, Ont.
The Township Council are about to construct a tile drain on the Town Line. Clerk, J. M. Govenlock, Winthrop, Ont.

McLennan, Alta.
The Edmonton, Dunvegan & B. C. Railway, Edmonton, may lay a pipe line to a nearby lake for a water supply.

Merritton, Ont.
The Municipal Council are about to construct macadamized and concrete roads by day labor. Clerk, Richard Clark, Merritton. Estimated cost, $10,000.

North Montreal, Que.
The Town Council are about to lay sewers and install a sewerage purification plant. Engineer, F. C. Laberge, 30 St. James Street, Montreal.

Peterboro, Ont.
The City Council have had plans drawn for laying an 8-inch watermain on Hunter and Water Streets. a 14-inch main on McDonnel Street and a 5-inch pipe on London and Donegal Streets. Engineer, R. H. Parsons.

The installation of an electrically operated auxiliary pumping plant is contemplated by the Board of Works. Chairman, W. Buller.

Port Colborne, Ont.
The Town Clerk, D. Alair, is receiving tenders on the construction of concrete sidewalks on Kent Street.

Sherbrooke, Que.
The City Council are about to start the construction of watermains by day labor. Requisite pipe is in stock. Approximate cost, $12,000.

Stamford Township, Ont.
Tenders will be received until May 13th by C. F. Munroe, Southend Post Office, Ont., for the construction of approximately eight thousand square yards of paving of various kinds on Lundy's Lane and Portage Road. Plans and specifications at office of Township Engineer, T. G. Gardner, Queen Street, Niagara Falls, Ont. Estimated cost, $12,000.

Toronto, Ont.
Tenders will be received until May 25th by the Board of Control, for the construction of Argyle Street storm overflow sewer, section number three. Plans at office of Works Department, City Hall.

Victoria, B.C.
The City Council are about to start work on the laying of concrete and asphalt pavements on Cowichan, Quamichan, Richmond and Bank Streets. Work to be done by day labor. Engineer, C. H. Rust.

Wallaceburg, Ont.
The construction of granolithic sidewalks on a number of streets has been authorized by the Town Council, and work will be started shortly. Clerk, H. E. Johnston, Wallaceburg.

Wingham, Ont.
The Town Council contemplate the construction of 4-inch granolithic sidewalks on John, Catherine and William Streets. Clerk, John F. Groves.

CONTRACTS AWARDED

Montreal, Que.
The City Commissioners have let the contract for the construction of main sewers in Edward Ward to A. Pion & Company, 1300 Papineau Avenue, and for the construction of West Broadway Sewer Outlet to Henault & Hefferman, 692 Church Street, Verdun.

Mount Forest, Ont.
The Town Council have let the contract for the construction of drains on Main Street to W. Hutchinson, Mount Forest, the contract for the supply of tile to F. Hunt, Holstein, and for grading to W. Henry, Mount Forest.

Sault-au-Recollet, Que.
The general contract for the construction of sewers and watermains has been by the Tonw Council to Bastien & Forest, Montreal.

St. Michel De Lavel, Que.
A contract has been let by the Town Council to A. Chagnon, 1216 DesErables Street, Montreal, for the construction of concrete pavement and asphalt sidewalks on concrete base. Approximate cost, $130,000.

Railroads, Bridges and Wharves

Goderich, Ont.
The Grand Trunk Railway Company are considering the construction of a bridge over the tracks at Maitland River Hill. Engineer, Charles Forrester, G. T. Rly. Offices, Stratford.

South Baymouth, Ont.
Tenders will be received until 4 p.m., June 1st, by the Secretary, Department of Public Works, Ottawa, for the construction of a wharf and warehouse at South Baymouth on Manitoulin Island in Township of Tehkummah, District of Algoma East Plans and specifications at offices of the District Engineer, Sault Ste. Marie, the Post Master, South Baymouth, and the Department, Ottawa. Specifications at office of MacLean Daily Reports, Limited, 25 Charlotte Street, Toronto.

Walkerton, Ont.
The erection of a steel and concrete bridge over the road at Walkerton Flour Mills is contemplated by the Town Council. Mayor, F. W. Lippert.

Willoughby Township, Ont
Tenders for the construction of three bridges will be received until noon, May 25th, by the Township Clerk, J. A. Plyley, Chippewa P. O.

CONTRACTS AWARDED

Arran Township, Ont.
The Township Council have let the contract for the construction of a concrete bridge to James Cole, Owen Sound, Ont.

Downie Township, Ont.
The general contract for the construction of a bridge has been let by the Township Council to James Hill, Mitchell, Ont.

Harwich Township, Ont.
The contract for concrete work in connection with the erection of a bridge has been let by the Township Council to A. S. Everitt, c/o G. W. Riseborough, Blenheim, Ont.

ESTABLISHED 1886

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New Policies in Aqueduct Construction

An interesting feature of one of the most noteworthy municipal engineering enterprises of a continent is the subject of an article published elsewhere in this issue. We refer to the one-hundred-mile Winnipeg Aqueduct—a work which occupies a unique place in water-works construction by virtue of the unusual conditions under which it will be built. The article is a leading feature of a special Water-works Number published by The Engineering Record of New York.

Our contemporary comments upon the fact that the several municipalities combining to form the Greater Winnipeg Water District have assumed direct responsibility for the selection and transportation to the work of the principal materials of construction. The district has built and will operate its own construction railroad, will purchase all cement directly instead of delegating this duty to the contractor, and will not only supply to the contractors sand and gravel but will also grade this material in the proper proportion for use as concrete aggregate. These three innovations in administrative policy are discussed in the article published on p. 526 of this issue.

Local conditions, of course, had much to do with the approval of this plan for the conduct of the work. The aqueduct line extends through almost impassable swampy country where no transportation facilities were available. Without the railroad it is probable that reasonable bids for construction could not have been secured. The direct purchase of the cement was decided upon to insure sound, waterproof construction. The decision to deliver graded sand and gravel to the contractors was influenced by the difficulty of securing, even in a single pit, material which did not show such wide variations in quality that its direct use by contractors would have entailed an amount and quality of inspection almost impossible of attainment and exceedingly costly. The purchase of cement by a municipality or State is not new and has its counterpart in the buying of bituminous materials for road construction by such State highway departments as those of Massachusetts and California. The large-scale delivery to contractors of graded sand and gravel for concrete, however, is believed to be decidedly novel.

It is clear that under the Winnipeg plan disputes between engineers and contractors regarding the quality of materials will be reduced to a minimum, if not entirely eliminated.

Cum Grano Salis

Of the new uses of concrete there seems to be no end and the latest is in connection with a dummy war fleet which is reported to have sailed to block the Kiel Canal and prevent the German vessels from getting out. It is needless to say that this war strategy could not have been brought to a successful conclusion unless cement were used to fill the holds of the vessels and thus lower them in the water. The plan as described was to take a number of old steamships, bought from the merchant service, including ships like the Campania, Oruba and Orotave, which have been fitted with dummy funnels, wooden turrets and guns, and their holds filled with cement to lower them in the water. This will make them torpedo proof, it is explained, because, owing to the hardness of the cement, a torpedo exploding would only rip off a plate or two in the hull. An outside belting of cement has been added to the hulls of these dummy warships to protect the engines and boilers. The report of a battle between a German torpedo and a dummy ship loaded and belted with concrete is yet to be made, but the result will be awaited with interest!—Concrete Cement Age.

Mr. Edison and the Edison Fire

THOMAS A. Edison has recently sent to the technical press and newspapers a letter in which he calls attention to a campaign against concrete which is being waged by various brick interests, taking the Edison fire as the text. According to Mr. Edison the entire purpose of the publication is to discredit and, if possible, retard the use of reinforced concrete in construction of fireproof buildings. Mr. Edison states that the evident purpose of the publication is to deceive and that it is in error in many ways. His specific criticisms are as follows:

> The results of the fire at my plant on December 9, 1914, are used in an entirely false and misleading manner. Of the seven reinforced-concrete buildings, none was destroyed. A small section of the upper floor of one of the buildings fell in, but was supported by the lower floors. The pamphlet referred to presents three views of this, the suggestion being that they were of three different buildings. The brick administration building to which it refers, which remains standing, was protected by an adjacent concrete building and was not subjected to the fire.
>
> Every brick and steel building which was attacked by the fire was completely destroyed, together with all the machinery they contained, while the damage done to the concrete buildings amounted to about 12½ per cent. and of the machinery contained in the concrete buildings 98 per cent. was saved and is now in operation. Manufacturing was resumed in some of the old concrete buildings within a few weeks after the date of the fire.
>
> Temperatures were far in excess of those in the ordinary fire, but reinforced concrete showed its superiority over any other fire-resisting material.

Contraband Articles

The following articles have been declared by Royal Proclamation to be absolute contraband: Powder and explosives specially prepared for use in war, ingredients of explosives—viz., nitric acid, sulphuric acid, glycerine, acetone, calcium acetate, and all other metallic acetates, sulphur, potassium nitrate, the fractions of the distillation products of coal-tar between benzol and cresol inclusive, aniline, methylaniline, dimethylaniline, ammonium perchlorate, sodium perchlorate, sodium chlorate, barium chlorate, ammonium nitrate, cyanamide, potassium chlorate, calcium nitrate, mercury, resinous products, camphor and turpentine (oil and spirit). Ferro alloys, including ferro-tungsten, ferro-molybdenum, ferro-manganese, ferro-vanadium, ferro-chrome. The following metals: Tungsten, vanadium, molybdenum, nickel, selenium, cobalt, hematite pig iron, manganese. The following ores: Wolframite, scheelite, molybdenite, manganese ore, nickle ore, chrome ore, hematite iron ore, zinc ore, lead ore, bauxite. Aluminium, alumina, and salts of aluminium; antimony, together with the sulphides and oxides of antimony; copper (unwrought and part wrought) and copper wire; lead, pig, sheet or pipe; barbed wire, and implements for fixing and cutting the same. It is further announced that the export of explosives of all kinds is prohibited to all destinations abroad other than British possessions and protectorates.

The War and America

An Old Country Viewpoint given by The London Builder

THE world has changed since the days of the Franco-Prussian War, during which time this country enjoyed a period of unprecedented good trade. Our cousins in America seem, if we may believe newspapers, to be most anxious for peace to come to Europe in order that trade and commerce may follow the normal lines. At least, that is the general impression produced on us, for it may be doubted whether America's warm commendation of the Papal efforts to induce Europe to allow His Holiness to mediate between the opposing parties is altogether inspired by altruistic motives. We are glad to note that Mr. Roosevelt, whose views and methods of electioneering we sometimes disagree with, has spoken with no uncertain voice as to the issues at stake and what should be the American attitude regarding them. We do not need the active participation of America, but it is well to have, and better to retain, her sympathies. The fact is that in the last fifty years finance and commerce have become more internationalized than they ever have been before, and to quote an American writer: "Everything that's done unequal injures all of them the same," and not even the possibility of the exploitation of South America consoles America for the shutting down of European markets. We hope our American cousins will produce great works in the only great country unaffected by the war, and that when we can turn once more with undivided attention to the prosecution of the Arts of Peace, we may find ourselves a "long lap behind," for in these matters we are glad if any country leads, since it is to the benefit of all.

With reference to the asphyxiating gas used by the Germans against our troops and those of our allies, opinions have been expressed by many competent and other people as to its constitution, comments The Engineer (London, Eng.). Thus the military correspondent of a popular halfpenny London daily paper described it as "chloride of sulphur." The special correspondent in Northern France of another London journal suggested it might be "a carbide di-oxide, probably mixed with ammonia." Other suggestions have been chlorine, bromine, sulphur dioxide, nitrogen peroxide, carbon monoxide, and carbonyl chloride. Some of these substances, for example carbon-monoxide, would, by themselves, not account for the appearance of the gas as reported, while others, for example nitrogen peroxide and carbonyl chloride, would probably be too difficult and expensive to prepare. Chlorine certainly seems the likeliest of the lot, but it is, of course, not in the least certain that it was an inorganic substance at all. This leads us to the suggestion which we would commend to the attention of military correspondents and others that, by discharging volumes of ammonia gas in reply to the enemy's chlorine, we could frustrate his knavish tricks and confound his chemistry. The resulting sal-ammoniac could be collected afterwards and used for the trench telephones.

The war is having the effect of raising the prices of all sorts of commodities in Germany. Cement is a case in point. The last price of the material in Hamburg was $1.55 per bbl. of 374 lbs. net, or two sacks of 187 lbs. net. This is an advance of nearly 50 cents per bbl. and is probably due to the large consumption of the material for fortification and trench work.

Direct Control Over Materials a Feature of the Winnipeg Aqueduct

Six Communities, Forming Water District, Build Construction Railroad, Supply All Cement and Deliver to Work Properly Graded Mixture of Sand and Gravel

THREE features of administrative policy combine to give to the work of building the 100-mile aqueduct from Shoal Lake to the city of Winnipeg and adjoining communities which have organized the Greater Winnipeg Water District, a unique position in the history of water-works construction: All materials will be transported by a municipally-owned and operated standard-guage railroad, built especially by the water district to serve the contractors; all cement will be purchased by the district and supplied to the contractors; all sand and gravel will be graded by the district at a large central plant and shipped to the work in the proper proportions for direct delivery to the concrete mixers. Thus, to an unusual degree, will the district have immediate, instead of indirect, control, not only over the delivery, but also over the quality, of the principal materials which will enter into its work.

Essential Parts of Project

The new water supply project, which was recommended in 1913 by a board of consulting engineers, consisting of Rudolph Hering, Frederic P. Stearns and James H. Fuertes, comprises, essentially, a low diversion dam at Indian Bay, an arm of Shoal Lake; 85.036 miles of horseshoe-shaped concrete aqueduct, the largest section of which is 10 ft. 9 ins. wide and 9 ft. high inside; about 10 miles of 5-ft. steel pipe; 900 lin. ft. of tunnel under the Red River, and 12,000 lin. ft. of 4-ft. cast iron pipe leading to the city reservoirs. The conduit is designed for a carrying capacity of 102,000,000 gal. in 24 hours, sufficient, on the basis assumed for a supply throughout the year, for 850,000 inhabitants. In 1913 the population of the Greater Winnipeg Water District was 225,000, of which 200,000 were in the city of Winnipeg. The rapid growth is shown by the fact that the 1913 population was twice that of seven years and five times that of fifteen years previous. The capacity of the aqueduct was based upon the assumption that the daily per capita consumption in some months would be as high as 120 gallons.

Including the railway line, which is about 105 miles long, including sidings, and an item of 15 per cent. for administration, engineering and contingencies, the estimated cost of the work is $13,045,600.

Source of Supply Remote

Winnipeg, like a great many of the smaller communities in the vicinity, is disadvantageously located for securing near at hand a supply of soft water. The ground and river water near by is so hard that it is unsuitable for manufacturing and laundry purposes, and is not very satisfactory for domestic uses. The only suitable water is found in the granite country 100 miles or so to the east and northeast of Winnipeg. This condition made it necessary to construct an aqueduct of unusual length.

Winnipeg is about 760 ft. above sea level and contains no hills on which reservoirs could be advantageously located. The country from which the new water supply is drawn is about 300 ft. higher than the general elevation of the city, and the available slope for the aqueduct, therefore, was only about 3 ft. to the mile. All this head is consumed in delivering the water into the city reservoir.

Greater Winnipeg Water District

Obviously a project involving a 100-mile aqueduct would have been too costly for any one of the smaller towns to undertake, but by combining their resources with those of Winnipeg five other communities will benefit by the new water supply from Shoal Lake. The Greater Winnipeg Water District comprises the municipalities of Winnipeg, St. Boniface, Transcona, St. Vital, Assiniboia, Fort Garry and Kildonan. The powers of the district are vested in an administrative board, consisting of the mayors and reeves of the municipalities, the mayor of Winnipeg acting as chairman. This board decides upon all broad questions of policy, while a commission of three members, two of which have already been appointed by the board, is responsible for the execution of the work in accordance with the board's direction. Matters involving decisions on technical questions are referred to the consulting engineer, James H. Fuertes, of New York City, and the construction work will be directed by the chief engineer, W. G. Chace.

The Construction Railroad

A big problem had to be solved before bids could be advertised—that of transporting materials to the work. In addition to its great length the aqueduct line traverses a swampy country which is well-nigh impassable when the ground is frozen, and it was realized that reasonable bids for the construction of the works could not be secured until means of access to the remote parts could be provided. The district decided, therefore, to open up the territory for construction purposes by building its own railroad and operating the line with its own forces, charging the contractors for the transportation of materials according to a schedule of rates published in advance of the receipt of bids. The route, about 90 miles long, exclusive of sidings, was surveyed, built and placed in service in a single working season, a feat of no mean magnitude considering the character of the country. The line is laid with 60-lb. rails, is well drained and designed for heavy and continuous traffic. It is hoped, on each contract, to maintain a rate of progress sufficient to complete the aqueduct by the fall of 1918, and it was of first importance that no delays in the delivery of materials should be caused by road-bed defects.

The terminus of the line is at Deacon, south and west of Transcona, where the Grand Trunk Pacific shops are located. A station and a storehouse for cement and other freight has been erected at Deacon. Cars of supplies, received from foreign roads, are delivered on the transfer tracks at Paddington, near Winnipeg, and picked up by the district's train crews and unloaded at Deacon or hauled to the work. The road is a single-track line with about ten permanent sidings and spurs, and arrangements have been made to cut the track and put in switches, if necessary, at points where contractors may best be served.

The contractors are arranging their plants on a plan calling for movable wooden platforms to lie lengthwise of the main track and span the railroad ditch. These platforms, upon which the sand and gravel will be dumped direct from the cars, are in units that can be picked up and moved ahead successively as construction progresses. At each camp the contractors will provide storage for cement. At the eastern terminal of the line, at Indian Bay, are yards and storage tracks. The railroad follows the aqueduct line closely for almost it entire length.

Cement Supplied to Contractor

The district's policy of supplying cement to the contractor, instead of allowing him to purchase this material, was adopted primarily in the interests of sound construction. The cement is delivered to the contractor at its cost to the district. Each contractor is charged for all cement supplied to him and is credited for the actual amount that goes into the work, as reported by the district's inspectors. In order to avoid disputes as to the quality of cement in case of defective work the contractor is constituted an inspector and is given all powers pertaining thereto. The cement will be inspected at the bins of the plant where it is manufactured. As soon as they are filled the bins will be sealed and the cement will be released only by the district's inspectors. It will then be shipped in sealed cars to the work or to the storehouse at Deacon. Accurate records of all cement leaving the mill will be kept, and no cement will be released until the tests have shown that it fulfills the requirements of the specifications. Several of the contractors have joined in employing an inspection bureau to check the district's tests.

The concrete aqueduct section has a width of 10 ft. 9 ins. and a height of 9 ft. inside.

Samples to be tested are collected automatically at a rate of 1 oz. per minute as the cement enters the bins at the mill. These samples will be divided among the inspectors for the district and for the contractors.

Grading of Sand and Gravel

Except for a few miles at its western end the aqueduct is of concrete for its entire length. Great stress was laid upon the requirement that materials and methods be such as to produce uniform, water-tight work. This result depends, to a large extent, upon the use of sand and gravel of suitable quality and proper grading. This responsibility the district also has assumed, instead of leaving it to the contractors, and will supply all the sand and gravel used throughout the work in properly graded mixtures made up at a large central screening plant at the district's gravel pit at about mile 30. Local conditions made this precaution necessary for the sand and gravel obtainable in the vicinity of Winnipeg varies widely in quality. It is a glacial deposit, in which the strata are not uniform, due to outwash in ancient times. The deposits are found in various locations over the whole length of the aqueduct line, and vary in depth and in their character of stratification, as to sizes of particles. Under such conditions to have given the contractors free rein in getting their own sand and gravel would have required a standard of excellence of inspection which would have been impossible of attainment and exceedingly costly, and would have resulted in the production of concrete containing too much sand or too much stone—in other words a porous concrete which it was essential to avoid. The district, therefore, decided to supply the contractor with sand and gravel mixed ready for use, and to this end secured extensive gravel deposits which were selected after thorough and careful inspection by test borings and careful mechanical analyses of samples of the strata made at the district's laboratory in Winnipeg.

The aim has been to obtain a thorough knowledge of the locations where coarse material predominates, where fine material is to be found and where material of an intermediate character exists. It will then be attempted to work with steam shovels through the different deposits in such directions and to such depths as will give a raw material necessary for a proper aggregate with as little waste as possible. With this in formation in hand it is expected that there will be not over 5 per cent. waste in the material collected by the shovel.

Central Screening Plant

The steam shovels will load into dump cars at the gravel bins and the cars will be hauled in trains to a central screening and mixing plant, where the raw material will be discharged upon inclined screen bars which will intercept any excessively large sizes. The material passing these bars will be raised by elevators to revolving screens and separated into four sizes —fine, intermediate, coarse and over-size. The oversize pieces will go to a crusher and thence again to the revolving screen. The material is sufficiently clean to obviate the necessity of washing.

The screened material will drop into three bins each provided with a spout in the bottom discharging on to a separate endless belt. These three belts deliver to a third belt running at right angles to them and leading to the storage bins. The fine, intermediate and coarse material is made to discharge on the conveyor belts at predetermined rates based analyses and inspection, so that the material as it enters the storage bin is properly graded.

Studies of samples from different pits indicate that there will probably be an excess of fine material, basing the proportionate amount of intermediate and fine upon the amount of coarse, and that if a definite mix of the three sizes were determined upon there would be a considerable waste of material. Laboratory investigations indicate, however, that by making use of some of the extremely fine sand, which would ordinarily be wasted, a very dense concrete can be produced with practically no waste. In such cases the coarser material serves simply as pudding stones. This concrete, in which the fine material has been used, has been found to flow easily and be water-tight.

The district has established a laboratory for concrete tests at headquarters in Winnipeg. Large specimens for crushing are, through the courtesy of the Engineering Department, tested in the laboratory of the University of Manitoba. Here 8-in. concrete cylinders are broken by compression, using various mixtures of fine, intermediate and coarse gravel; blocks are subjected to permeability tests in the district's laboratory.

Delivery of Graded Material

From the storage bins at the central plant the properly proportioned mixture of sand and gravel will discharge into trains of air-dump cars which will be hauled to the work and dumped upon the wooden platform along the aqueduct trench, previously referred to. The contractors will take the sand and gravel from the platform, working at right angles to the track so as to prevent any segregation of material. Experience may show that segregation may occur to a small extent during transportation, or that some of the fine material will be lost through cracks in the cars. If so, arrangements to ship out extra sand, as may be necessary, will be made.

Construction Methods to Be Uniform

The aqueduct has been divided into five contract sections, awarded to three contractors. In order that uniform methods may be followed on each section of the work all of the contractors have arranged to secure one type of form from the Blaw Steel Construction Company, thus systematizing methods of concreting throughout the entire job. The inside aqueduct forms will be collapsible and plans have been formulated for handling the work in such a way as to permit continuous progress both on straight portions and on curves.

A very important construction feature will be the use of straight sections of forms on curved portions of the aqueduct. The curved alignment will, in reality, be a series of tangents of 15-ft. lengths; at the gaps in the forms where these angles occur wood fillers will be used. All of the curves in the alignment have the same radius, 50 ft., and no curve will require more than three 15-ft. sections of form. On each section of each contract it is planned to make the concreting progress 90 ft. daily.

The schedule of work laid out for the year 1915 is shown in the table below.

The chairman of the administration board of the Greater Winnipeg Water District is Mr. R. D. Waugh, Mayor of Winnipeg. The two commissioners are Mr. S. H. Reynolds, C.E., chairman, and Mr. James H. Ashdown, who was Mayor of Winnipeg when the water question was investigated in 1907. To Mr. Thomas R. Deacon, C.E., President of the Canadian Club of Winnipeg, and former Mayor of the city, is due much of the credit for making a reality of the water supply project for the district. It was under his administration that the project took definite shape, that the Greater Winnipeg Water District was organized, that the surveys were made, the railway built and the contracts for the construction of the aqueduct awarded.

Contract No.	Contractor	Length in Feet
30	J. H. Tremblay Company, Limited	20,600
31	Thos. Kelly & Sons	27,000
32	Winnipeg Aqueduct Construction Company ...	32,660
33	Winnipeg Aqueduct Construction Company ..	21,020
34	Winnipeg Aqueduct Construction Company ..	10,800

Mr. W. G. Chace is Chief Engineer of the work and Mr. James H. Fuertes, of New York, is Consulting Engineer.

An article dealing with the methods and cost of making test borings for the Winnipeg Shoal Lake Aqueduct was published in our issue of April 21st last. For the information published herewith we are indebted to The Engineering Record, of New York City.

The Proper Method of Mixing Concrete

It is no doubt almost an accepted principle among contractors that the order of placing concrete material in a mixer is of no importance. Occasionally a specification is written, and more rarely followed, under which it is required that the component parts of the concrete be placed in the mixer in some prescribed order; but the general practice is to throw in the cement, aggregate and water in any convenient order, or, in case a measuring hopper is employed, all at once. In hand-mixing, of course, the old practice of first mixing the dry sand and cement still prevails, but that is because when all the materials are thrown on the board together and doused with water it is difficult to get men to turn over the mass of wet concrete long enough to insure a well-mixed mortar, says a writer in Concrete Age. The stronger and more efficient machine is thought to remove this difficulty.

Cause of Density of Concrete

Some pressure tests on concrete pipe were made recently by a company attributing the density of the concrete obtained—first, to its richness—a 1:1½:2½ mix being used—and, second, to the method of mixing with especial attention paid to the order of placing the materials in the mixer.

According to the method used, the mixer is first charged with the proper amount of water (established by experience and observation), and into that the cement is dumped; the mixer is then turned until a well-mixed grout results. Into this is dumped the stone, and after this has been turned sufficiently to insure the coating of all the stone particles the sand is put in and the turning continued until the sand particles are well covered and have apparently filled all the voids in the cement-coated stone.

It may be that the users of this method are correct in their assumption that the order of placing is responsible for the exceptionally dense concrete which they achieve, but others think that the effectiveness of the method is due not so much to the order of placing the materials as to the length of time taken between placing the separate components, which added together make the total length of time of mixing somewhat longer than in the normal mixing of concrete.

This naturally leads to the query, "Is enough attention paid to the length of time of mixing in machine-mixed concrete?" Are not most contractors too hasty in getting the batch out of the mixer? A piece of western construction is reported in which it is stated that 2,150 cubic yards of concrete were mixed in an eight-hour day in four one-yard mixers. This is somewhat more than one mix a minute for each machine. Regardless of the type of machine used, would not a two-minute period give a concrete sufficiently better to warrant the use of more machines, with their additional cost of purchase and operation?

As construction is now generally carried on the time of mixing is governed entirely by the observing eye of an inspector or superintendent. When it seems to him that the various parts that go to make up the concrete have reached a proper intermingling the batch is dumped. If it is a fact that after a certain amount of mixing, easily determined by the expert eye, the component parts of the concrete become so thoroughly intermixed that no perceptible increase in quality of the concrete will result from further mixing, this method of ocular inspection is correct enough, but if it is probable that an increase, even slight, in future strength may result from mixing the concrete beyond the time when it seems to be thoroughly mixed, then in the scientific development of concrete construction such time should be ascertained.

We believe that some tests have been carried on to investigate the proper time of mixing concrete, but these tests have not been so conclusive nor have they had such wide publicity as to be of much value. There is a field here for future investigation, which some testing laboratories should take up soon. Undoubtedly most of the concrete which is made is mixed in too short a time. If by adding to that time we can increase the density of the concrete, and thus improve its water-resisting qualities or prolong its future life, we are certainly justified in the additional expense of extra mixing. It may be difficult to estimate precisely the effect of this additional mixing, but unless there is absolute certainty that it does no good it would be at least a good insurance. The difficulty, of course, is not in determining whether additional mixing is desirable, but in ascertaining some method by which the exact time of increased mixing may be rationally determined, and that is the field of the testing engineer.

Economics of Concrete Construction

By DeWitt V. Moore

CONCRETE is a peculiar building material in that it is manufactured on the job, whereas stone, brick, steel and wood are delivered on the site ready for the structure. The cost of stone as delivered is determined by its quality and hardness and by the distance of transportation and the cost of quarrying and dressing. The cost of the brick is determined by the quality of the clay from which it is produced, the method of transportation, and also by the cost of labor to handle, sort, and select. The cost of steel is more nearly consistent; but even this material is affected by the character of the material, the shapes into which it is rolled, the sizes of such shapes, and the distance of transportation. The cost of timber is likewise affected by the character of the wood, the size of the pieces, the grade and the distance of transportation.

In all of the foregoing standard building materials, no man would think of bidding without first ascertaining what was required, and then obtaining a price from those who were qualified to furnish the specified material. In the case of concrete, it would appear that the elements entering into its construction are in most cases entirely overlooked—that concrete is treated in the estimate without any regard to the varying character of the materials and proportions entering into it. This is not as true now as it was a few years ago; but it is still true in a great many proposals.

Selection of Gravel or Stone.—Most specifications allow either gravel or stone to be used. Where good gravel can be obtained, it is preferable to stone from a cost standpoint, and it is more easily handled throughout the entire operation of mixing and placing. Broken stone is usually obtained from quarries, and must be transported by railroad cars, unloaded by hand, and then hauled to the location of the work. Gravel, on the other hand, when loaded, is hauled directly to the site of the work. From a cost standpoint, therefore, we have two reasons why gravel is preferable: (1) Under ordinary conditions there is less manual labor connected with its delivery; (2) there is less cost for manual labor due to the nature of the material—a laborer can shovel approximately twenty per cent. more gravel than stone under the same conditions.

If the gravel is good, the resulting work is equal to or better than broken stone concrete. A good gravel for concrete should be of varying sizes wherein the size of the pebbles ranges downward from, say, 2½ inches to ¼ inch. The proportions of sizes should be such that there is approximately fifty per cent. of each size with reference to the next largest. Concrete made of such materials will be homogeneous, dense and of great strength. Either gravel or stone should be watched very carefully for foreign materials, such as lumps of clay from stripping the hardpan strata, sticks, decayed material, etc. So-called yellow gravel is not necessarily a sign of weakness, although such a deposit should be examined carefully. In many cases such a surface discoloration is caused by leachings from deposits of strata of oxide of iron or other materials.

Selection of Sand.—Much that has been said about gravel is true of sand, except that sand is more important, in a sense, than gravel. Sand should be relatively clean and of varying-sized grains. Such a sand is much better than when of even-sized particles, and I think I am safe in saying that silt up to five per cent. will not affect the strength of the resulting concrete. If, however, sand is silty to any such extent, care must be taken that the work is cleaned every morning (this same remark applies to the gravel); for if this is not done, there will arise to the surface of each day's work a soft, slimy substance which has no strength and which will form strata of demarcation between the successive courses. Other things being equal, it is better to import sand at an increased cost, using local gravel, than to use local sand and import gravel and stone.

Selection of Cement.—At the present time there are so many brands of Portland cement of recognized value that as far as quality and ability to withstand tests are concerned there is little choice. When it comes to large and important work, however, it is well to consider the capacity of the plant and be sure of its ability to deliver the cement on time and in the quantity required.

Selection of Machinery.—Various types of work naturally demand various types of machinery and arrangement, but in general it may be said that a small mixer is not economical. Use nothing smaller than an 18 cu. ft. mixer, which will deliver ½ cu. yd. of mixed concrete, and use a larger mixer than this if the work will justify it. Also in general it may be stated that each batch from the mixer should be handled as a whole as nearly as possible to the place of deposit. The wheelbarrow is no longer the primary method of transportation of concrete. There is no doubt as to the consensus of opinion being in favor of batch mixers; but whatever the type adopted, it will be well in the long run to install 20 to 25 per cent. more boiler and machine power than is specified by the manufacturer.

When Hand Mixing is Justified.—Hand mixing cannot be expected to be as uniform as machine mixing; and yet, if proper care is taken under intelligent supervision, good results can be secured. From the standpoint of cost hand mixing is preferable when the work is so small as not to justify the installation of a machine. For instance, on a job of a couple of hundred cubic yards probably $100 would be expended in installing and rigging the mixer, or a cost of 50 cents per cubic yard; and it is doubtful if hand mixing would cost any more than this difference. Again, hand mixing is preferable in connection with large work where, in order to reach isolated portions of the work, it is more economical to mix by hand than to wheel long distances. Hand mixing is most important when constructing floors, sidewalks and pavements on a natural gravel foundation where it is possible to shovel material directly upon the opposite side. Under no circumstances can machine mixing compare in cost with this method where conditions will permit of its use.

Mixing Concrete.—For ordinary work concrete should be mixed wet, soupy. From the standpoint of quality, care of handling and manipulation, resulting finish and cost of surfacing, there is absolutely no question as to this point. This choice of wet concrete applies to walls, bridges, reinforced concrete buildings, etc., but for sidewalks and pavements economy demands a dry mixture requiring tamping in order that the workmen applying the finish may follow as quickly as possible after the depositing of the concrete.

Placing Concrete.—No concrete should be placed until it is definitely determined that the forms are correct and properly braced. It is cheaper to delay the work than to cut out work already done. Concrete should be placed as quickly as possible after mixing, and not be disturbed afterwards. When being placed it is abused to the greatest extent. We take great care of a green brick wall, but do not hesitate to walk over and conduct operations over concrete which has not reached its final set, thereby destroying the surface of the concrete for all time. While this may not be serious in some cases, it is certainly not desirable in thin concrete slabs. Concrete is better placed by chutes than by wheelbarrows, cars, etc., for the reason that, by chuting, the material is kept constantly in the process of mixing until it is deposited in the work. With barrows or carts the heavier particles settle to the bottom, and when the mixture is dumped into the work there is a separation. Chuting also allows the placing of the concrete with a minimum of working back and forth over the work just completed.

The ideal condition would be the completion of the work without interruption; but, as this cannot be attained, care should be taken in the location of and in the manner of constructing the connection joints as the work progresses. Breaks should be made preferably at the centre of columns transverse of girders. Slab spans may be joined longitudinally over centres of girders or beams, but this method should be considered a second choice. Columns should not be poured all at one time. Generally a height of 4 ft. should be allowed to set for three or four hours before the second pouring. Slabs, girders, and beams should be poured continuously up to the determined joint where stop forms have been placed. The method of pouring girders up to the bottom of the slab, and then afterwards placing the slab, is not desirable. The method of pouring a slab and allowing the material to slope down over the girder, and then beginning the next day, gives a slip-slab joint which cannot be recommended. In all concrete work stops should be made on horizontal and perpendicular lines at the locations mentioned, the forms being carefully placed.

Finish of Concrete.—We are wrong in our present practice of finishing concrete surfaces. The surface finish of a piece of concrete should be an integral part of the main construction, and of the same mixture and same composition. The time was when we were called upon to plaster and apply a surface coat to vertical surfaces. After a good many years of argument by the practical concrete workman, we have reached a point where such surfaces are finished generally by spading, so as to bring the finer particles to the surface and force the large particles back so that they are not exposed. We are, however, following the old practice in respect to horizontal surfaces, applying a thin coating of rich mixture on top of our cheaper concrete base. In order to secure the best results we should so manipulate our concrete as to bring our finish to the surface from the material of the concrete base. When we reach this point we shall have less trouble with checking, insufficient bond, and so on, and such a finish can be obtained easily by the use of proper tools for tamping.

Construction of Forms and Centres.—If there is one element entering into the cost of concrete which is neglected, it is the cost of forms and centres. So far as is known to the writer, no architect or engineer ever submits to a bidder a plan for this part of the construction. Even the specifications are vague and indefinite, leaving it to the individual contractor to plan his own work. Some go to one extreme, and use a great deal more timber than is necessary; others to the other extreme, and use so little and of such light construction that the work is out of line and out of plumb. When it is considered that the cost of forms and centres represents from 20 to 33 1/3 per cent. of the cost of every cubic yard of concrete placed, under average conditions, it is hard to understand why the subject is not given more consideration.

Ordinarily it is left to the carpenter boss to put up something by rule of thumb and by his judgment based on past experience. There is nothing practical about such a method. The designs for the forms of any structure should be planned carefully to accomplish the results with a minimum of material and labor, giving due consideration to the maximum amount of salvage in the material. It is our contention that, accompanying the plans for any structure, there should be prepared by the engineer and architect a sheet detail drawing showing how forms should be constructed, thereby insuring quality of workmanship and placing all bidders upon the same basis. If this is done there is nothing to hinder any contractor from submitting an alternate design.

Types of Reinforcement.—Types of reinforcement now on the market may be classified as follows: (1) Plain bars, either medium or high-carbon steel; (2) plain bars, deformed or cold-worked to secure deformation (this classification includes cold-twisted and hot-twisted square bars); (3) special patented types of plain or deformed patented bars; (4) built-up bars—meaning thereby combination of various-sized members in order to utilize the quantity of steel to the best advantage; (5) built-up frames composed of bars of various sizes, generally used for beams, girders, and columns; (6) floor-slab reinforcement of sheet metal, sheared, punched, or expanded in order to distribute the steel through the mass, and delivered in sheets; (7) cold-woven wire similar to fencing material, delivered in rolls; (8) secondary reinforcement in the way of hoops or bands for columns, stirrups for beams, and spacers for rods, all of which may be made of hoop iron or wire.

Selection of Reinforcement.—Considering the various types of reinforcement just mentioned and the many modifications now on the market, it is a difficult proposition to select the best; and generally the selection is determined by the price submitted by the commercial engineers bidding under sub-contract to furnish the metal. To a certain extent this method is dangerous, but it is hard to suggest a remedy. Individual preference and experience are always a very large element.

Placing Reinforcement.—The design of a concrete structure contemplates the placing of the reinforcement in exactly the position shown by the plans and cross-sections of the various members. Designers are usually quite conservative in their allowance for the protection of steel by fireproofing the concrete below it; and the contractor had better err on the safe side and take advantage of this allowance, rather than keep above same. Often reinforcement—and especially light bars, expanded metal, and wire fabric—are laid upon the forms, and then afterwards manipulated by a hook as the concrete is placed, jerking the reinforcement upward so that the concrete may flow underneath. This is dangerous, inasmuch as there is no gauge to determine the final position of the reinforcement; and if the concrete flows under the reinforcement in too large a quantity it is almost impossible to replace the reinforcement without rebuilding the entire work.

Automatic spacers and devices for the accurate placing of the steel are readily obtainable, and should be used. Naturally there is some increase of cost due to such a method—but it is money well expended. Special care should be taken in placing steel in girders and beams to distribute and arrange the bars so that each individual part may be incorporated within an individual part of the concrete. The reinforcement for columns should be accurately made, and wired with the hoops and stirrups in place before it is erected in place ready to build the column forms around it. While good results can be secured from bar reinforcement, the author at this time is in favor of built-up columns of light structural shapes, for the reason that the integrity of the whole building depends upon the column construction, and a failure of any one column is liable to result in a failure of the entire building. Perhaps the most important reinforcing detail in respect to proper placing is top reinforcement or reverse flexure bars. No matter what the designer may have in mind in theory, or how these bars are proportioned with reference to the main reinforcement at the centre of the slab or beam, it is absolutely essential that these top bars be placed accurately and that they be not disturbed afterwards. This is easier said than done. The main reinforcement is embedded in the solid concrete below the surface, and is protected from disturbance. The top reinforcement is close to the surface, where it is affected by the future operations, and also where the free ends project in case of a break at the joints in the progress of the work. These free ends, if jarred, will often break the bond of the half-bar extending into the work. The placing of loose stirrups is a task requiring very careful supervision; and this is one of the strong arguments for built-up sections wherein the stirrup shear members are rigidly connected. Finally, the employment of an expert mechanic or steel worker at increased wages over common labor is justified by the importance of this part of the work.

Proportions of Concrete.—It is very usual to specify 1:2½:5 or 1:3:6 for the proportions of cement, sand, and gravel for plain or monolithic concrete work; and the usual specification for reinforced concrete is 1 part cement, 2 parts sand, and 4 parts gravel, although some engineers specify a richer mixture for columns. Inasmuch as there still exists a general ignorance on this point whereby these specifications are understood as being 1:7½ or 1:9 or 1:6 respectively, it would seem best that the specifications should read that a mortar should be mixed of one part of cement to so many parts of sand, and this mortar should then be mixed with so many parts of the aggregate.

Proportions of Concrete for Strength.—The ideal mixture of concrete assumes that the aggregate and mortar are mixed in such proportions that the most dense, solid, and homogeneous mass is secured. This result may be secured by expert engineering supervision, but in reality the good common sense of the expert concrete laborer may be depended upon. The artisan who is accustomed to handle concrete can determine, by the appearance of the concrete mixture and by working the mixture, whether he is securing the best results; and, after a long experience, the author is inclined to say that he would just as soon trust a practical common-sense laborer's opinion as base his work upon the report of a so-called expert engineer.

Proportions of Concrete for the Cost.—If a 1:2:6 mixture will satisfy the necessary strength required for construction, there is no necessity of specifying a 1:2:4 mixture, inasmuch as the first mixture will require approximately 1 bbl. per cubic yard, while the latter will require 1½ bbls.—a difference of at least 50 cents per cubic yard in actual cost. In many cases for footings and monolithic work, ¾ bbl. per cubic yard of concrete is all that is necessary. Why specify a rich mixture when one with a less amount of cement will answer the purpose? If the contractor is at all skilled in estimating, the extra cost will be included in his proposal.

Estimating after Proper Analysis.—No proposals should be made upon a concrete job until a proper analysis has been made of all the elements entering into the construction. It is not sufficient to say or to guess that the cost of a cubic yard is so much, but, instead, an analysis should be made of the cost of a cubic yard of concrete under the conditions specified. There are a great many elements entering into the cost determined by such an estimate, which will be stated briefly in the following:

Cost of Materials.—Whether the concrete is to be made of a natural mixture of gravel, or of stone and sand in various proportions, determines the cost of the aggregate. The amount of cement depends upon the proportions of the concrete, as also do the amounts of gravel, stone, and sand. The cost of water for proper manipulation should not be overlooked. In cities the cost of water is determined by rates of 9 or 10 cents per cubic yard. Outside of cities the cost depends upon the labor necessary to secure the water.

Cost Affected by Locality.—Concrete work remote from populous centres cannot be done at the same price as that close to such centres, unless the work is so remote that a permanent camp can be constructed and the laborers held by the very remoteness of the work. Work that is at some distance from the point of supply must bear a charge for the transportation, handling, and hauling of raw materials. This is a labor charge which is chargeable to material, inasmuch as the materials should be considered as f.o.b. the job; but nevertheless, the cost is increased per cubic yard in the proposal.

Cost Affected by Character of Labor and Character of Work.—Good American labor will accomplish at least fifty per cent. more a day than foreign labor. American labor, however, is scarce and preferential. American labor differentiates between clean-cut concrete work under favorable conditions and concrete work under adverse conditions, excessive water, and other disadvantages. The same work may cost a great deal more when built under unfavorable conditions than when built in town.

Cost of Work as Affected by Forms.—A wall of concrete 27 ft. thick may be retained by the same foms and the same amount of form labor as are necessary for a wall 1 ft. thick. In the latter case the cost per cubic yard of concrete is 27 times as great. It is not safe, therefore, to estimate the cost of forms on a basis of guess price per cubic yard of concrete. Each individual job should be estimated for the amount of timber work as carefully as for any other item. It does not matter whether the cost is estimated on the basis of floor foot or concrete surface or upon a basis of feet board measure of lumber; the result is the same, inasmuch as this important branch of concrete construction receives individual consideration.

Cost of Work as Affected by Centres.—There seems to be a misunderstanding as to the separation of forms and centres. Properly speaking, forms consist of the timber work to form those members of concrete construction, such as columns, girders, etc., which must possess a certain regularity of form and evenness of outline. Centres, properly speaking, consist of timber supports for floor-slabs, bridge centres, etc. Where the great amount of labor on timber work is expended solely for the purpose of supporting the mass at a uniform or definite height the unit cost is much less than for forming for individual members.

Cost of Work as Affected by Reinforcement.—Fabricated reinforcement will cost much more delivered to the job than loose bars, but, on the other hand, will cost much less to place in position. It is needless to say that a job where reinforcement is made up of small bars less than ¾ inch will cost much more a ton for labor than for large sections. Good judgment must prevail in this particular. It is very seldom that an estimate will be made based on the labor and the tonnage of each size bar. Rather it is the practice to strike an average labor price in harmony with the class of work to be encountered with reference to the different sizes of reinforcement. It is well to remember, however, that it takes practically as long for the steel man to place and wire a ⅜-inch bar as a ¾-inch bar, while the tonnage is only one-fourth as great; and this point should be kept in mind in making an estimate.

Cost of Work as Affected by General Charge Items.—There are a great many items of the cost of concrete work which are not included in the cost of materials, labor, forms, centres, reinforcement, etc. These costs consist of installing and removing machinery, coal, oil, repairs and fittings to machinery, general charge items such as rope and bolts, and the loss on petty tools such as shovels. Such costs may be determined on the basis of so much a cubic yard; or, preferably, they may be determined on the percentage of labor on different classes of work. No matter what the method of determination, the costs are real expenses, and are as justly chargeable as those for the gravel or cement entering into the work.

Summarized Detail Estimate of the Cost of One Yard of Concrete.—In line with the foregoing remarks and the importance of the detail study of concrete, we submit the estimate for a cubic yard of concrete which according to specifications should be of a 1:2:4 mixture to be used for purposes of building construction; and making these estimates, we desire to lay emphasis on the fact that no two jobs cost the same when itemized in this way:

0.9 cu. yd. gravel at $1.20	$ 1.08
0.45 cu. yd. sand at $1.00	.45
1½ bbls. of cement at $1.20	1.80
Water	10
200 ft. B.M. of lumber at $20 used four times at 20 per cent. less each time used, less 40 per cent. salvage.	1.08
Reinforcement, 150 lbs. per cu. yd. at 2½ cents	3.75
Total cost of material	$ 8.26
Labor centres 120 ft. at $20	2.40
Labor forms, 80 ft. B.M. at $30	2.40
Labor reinforcement, 150 lbs. at 1½ cents	.75
Total labor	$ 7.55
General charge items, proportion of labor 15 per cent.	$ 1.13
Total actual cost 1 cu. yd. concrete	$16.94

Each individual job that is encountered should be estimated in this same manner. It might not be necessary to throw the cost of forms and centres, reinforcement, etc., into the cost per cubic yard of concrete; but however the estimate is made, it should consider all these items, and in the end the result will be the same. If, in addition, there is to be applied a surface coat of finish, its cost must be added.

If there is only one item which adds to the cost, it is the form and centre work. For instance, in the detail estimate just given the cost of lumber and form and centre labor is $5.88. If the work had been twice as heavy, the cost of this labor would only have been half as much a cubic yard. This should bring home to every estimator the importance of dealing with the temporary structural timber work as a separate unit. Personally the writer would rather guess at the amount of reinforcement per cubic yard than guess at the cost of forms and centres. The cost of labor is dependent upon the amount of concrete placed on the square foot of area of work covered, inasmuch as the cost of placing depends upon the distance travelled and the amount handled. The greater the distance, the less the quantity and the more cost per unit; and the less the haul, the greater the mass and the less the cost per unit. Such labor cost may reach anywhere to $5 a yard; and it is suggested that a careful study be given each job to determine the amount of foot-pounds of work necessary to complete it.

Cost Records and Cost Accounting.—It is suggested and recommended that each separate and distinct job should be given a detail cost recording in line with the foregoing, in order that future work may be estimated properly. It is a very simple matter to arrange a cost record book with a system of time reports, so that such records may be obtained and recorded without increase in labor or cost.

Contractors and the Public.—During the last few years much has been written on the standing and relation of contractors to public officials, to engineers and to parties that let work to contract, but little if anything has been written as to the standing of contractors in their relation to the public. Contractors and the public should be closely allied, especially as regards public work.

For the construction of public structures contractors play an important part. It has been through them that many millions of dollars have been saved in the United States and Canada to the taxpayers, the public. This has been due to the fact that not only have the contractors done work better, but also much cheaper, than that done by the day labor method. For this reason there should be a close bond between contractors and the public, as the cheaper work is done the smaller will be a citizen's taxes. This is also the case when better work is done, as if a structure serves its purpose longer less money will have to be raised to maintain and renew it. This is especially true of road and street work. Thus the contractor is a real friend to the public—hardly a philanthropist, for he in turn is paid for his work, but if the contract system were done away with in America taxes would be bound to be higher.

Unfortunately the ideal relations that should exist between contractors and the public do not exist, and contractors are looked upon, to a great extent, as grafters. This has been due to a number of causes.

First, contractors themselves have been to blame, not so much to-day, but in the past. It has been a prevalent idea that public money was legitimate prey to any one. The farmer felt that work on the country roads should be done by him, as in this way he worked out his tax, or got back part of the money he had so paid. He was not very zealous in doing his work. To stop and talk for half an hour did not worry him, as he felt he was partly his own boss, and it was not any one's business if he did waste his time. The man working for a city is wasteful of materials and thinks nothing of loafing, for he says, "the city is rich." Thus it was common, not only for these people, but also for contractors, to think the public treasury was there to be looted, and combines and deals were made to parcel out contracts. This idea was strong, and the public has learned that it much suffer in consequence, so that to-day more is demanded of those who work for the public.

Then contractors have been blackmailed by politicians and dishonest public officials so that they have been compelled to give up some of their profits to these men. This still goes on in some cases, but there is a demand from the public that it should cease and the practice is not as prevalent as it once was.

These things have caused the public to distrust contractors and to believe that they have made fabulous fortunes on public contracts, and the daily papers have added to this belief by publishing sensational articles and cartoons of contractors looting the public treasury. In most cases contractors have been more sinned against than sinning.

A contractor is viewed by the public as being a sharp, shrewd man living on the public, making exorbitant profits on his work, and being the friend of public officials and politicians. Because of his supposed wealth the contractor is respected somewhat, and even held in awe, and the public is always interested in him and his doings. This was shown in the case of James B. McDonald, the contractor at the head of the company that built the first subway in New York. His name was known to nearly every man in the city. He was looked upon as a genius, as a multimillionaire. The name of the engineer who planned and supervised the construction of the subways was hardly known to the public, and the financiers who backed the contractor and made his work possible were given scant notice. This contractor was an able man, but he only followed the engineers' plans and instructions; and sub-contractors, many of whom were unknown to the public, did the actual construction. Mr. McDonald was not a wealthy man, and the greater part of the profits made on the subway were tied up in litigation and ultimately went to his backers. Yet his work placed him at the head of the contracting profession in New York City.—The Cement World.

Faith at Waterloo

NAPOLEON hurled the flower of France against Wellington's solid squares of British steel. The Iron Duke re-formed his broken lines and waited for the next charge. Napoleon was pitiless: Wellington, stolid. The former took a chance: the latter had faith in his men, faith in the allies, and above all faith in Blucher. These are times of trial; for some men these are times when business faith is shaken to its foundations: yet Wellington's squares held until Blucher arrived. Wellington had confidence—and confidence is half the battle. The manufacturer advertising his products in the engineering and contracting world must have faith in the value of advertising. Faith won the battle of Waterloo, and faith will win the war in Europe and business battles in Canada.

It is reported that at the works of the Bethlehem Steel Company, South Bethlehem, Pennsylvania, ten per cent. of the workmen were formerly Germans, but that the number has now been reduced to four per cent. Bomb plots, with the object of interfering with the prduction of war materials for the Allies, are feared. A guard of twenty-five men is constantly on duty, and each department of the factory has been separated from other departments, while the workmen are not allowed to pass from one building to another without a special permit.

Strengthening the Macadam Road to Meet Modern Traffic

(Contributed)

FOR many years the navies of the world have seen a contest between the maker of armour plate and the gun. It began when the Merrimac sailed out before the fleets of the United States and let the cannon balls bounce off its iron-plated sides, whereupon all the naval guns in the world became obsolete. So guns of higher power were created—guns which punctured the armour plate of that day with neatness and dispatch. Thereupon the armour-maker produced heavier and stronger steel; whereupon the gun-maker again produced more powerful guns.

West Webster Street, Chillicothe, Mo., showing condition of road BEFORE Tarvia was used.

A similar contest, as old as man, has been waged between the vehicle and the road. Thanks to the genius of MacAdam there was a long period in recent history when the road easily withstood the vehicle. The smooth, hard macadam road, however, invited the development of the automobile, and still more recently the motor truck, and macadam roads were doomed to swift and general destruction. Now, however, the road is getting the better of it again, thanks to the development of the modern, bituminous binders of which Tarvia is the best known.

Many of the old macadam roads do not require rebuilding, and processes have been developed for applying Tarvia to the old surface in such a way as to preserve them from the ravages of modern traffic. In building new roads or rebuilding the old, Tarvia binders are used, these being so strong that the stones are held in place despite all the efforts of traffic to dislodge them.

It is now ten years since these modern binders were introduced into this country and the experience of many communities runs back over the whole period. In Newton, Massachusetts, for instance, there is a section of Newton Boulevard which was treated with Tarvia nine years ago at a cost of 14c. per square yard. The cost of maintainance of the whole Newton Boulevard, comprising five miles of the most heavily travelled automobile road out of Boston, has been brought down to $1,200 a year. The road is 60 ft. wide.

Cleveland, Ohio, has a stretch on Bellflower Road which was put down in 1905, and which has been in service ten years. Many other towns experimented with Tarvia in the early days, and have now settled down to the use of this material as a fixed policy. Plainfield, N.J., one of these, now has thirty-six miles of well-kept, tarviated road, the result of a consistent and economical policy that was inaugurated in 1908. Another town is Westfield, N.J., with upwards of nineteen miles of smooth roads that have been maintained and made dustless with Tarvia at a very low cost.

Important parks and cemeteries have adopted Tarvia for their roads. The tarviated roads are clean enough and dry enough to use as walks and at the same time the surface will withstand the transportation of heavy monuments. Graceland Cemetery, in Chicago, began to tarviate its roads in 1908, and now it has completed the treatment of its entire system. Government engineers have been using Tarvia largely in the roads about Washington, the White House Driveway having been maintained with this material since 1911.

The use of tarvia-reinforced roads may be said to be in its infancy. The automobile has spread over the continent and the motor truck is fast following. The latter is already a serious problem in England and in some of the most congested centres of the United States. The more efficient the motor truck becomes, the larger loads it will carry, and the greater will be the burden it imposes on the roadway. Motor bus and jitney also bring their problems.

Plain macadam without bituminous treatment must become everywhere a thing of the past as it has already done in many localities. Unfit for modern traffic it must be discarded in favor of roads that are firmly united by some plastic bituminous binder like Tarvia.

In Switzerland a fireproof building material is made by compressing Portland cement and asbestos fibre into blocks.

The same street AFTER Tarvia was used.

The Evolution of Asphalt Pavement Construction in Toronto

By Geo. Powell, Deputy City Engineer

IN the year 1888 the first asphalt pavement was laid in Toronto, on Bay Street, between King and Front Streets. The construction of this pavement created a great deal of interest, as it marked the inception of an entirely new class of pavement in Toronto. Almost any time during the day crowds could be seen on the sidewalks, showing a very deep interest in what was going on, especially when the surface gang, composed mostly of negroes, started to work.

The men employed on the surface work were practically all imported from the States, and it was quite a long time before there were enough local men sufficiently well broken in on the work to make it unnecessary to retain the negro experts longer. To-day there are perhaps two or three colored men still engaged in the work of laying asphalt pavements.

Mr. George Powell, Deputy City Engineer of Toronto.

At the present time the construction of any pavement, be it asphalt or something else, creates only a passing interest, to such an extent have the people become accustomed to modern methods of building good roads.

The specifications governing the construction of this first pavement were somewhat meagre and apparently the five-year guarantee demanded was thought to be sufficient protection. The foundation was composed of 6 ins. of hydraulic cement concrete of the following proportions: 1 part hydraulic cement, 2 parts sand, and sufficient crushed stone or brick to give a surplus of mortar when rammed. A rather indefinite specification, you will admit. However, the work must have been good, for a large portion of the original concrete is still on the street and does not show any signs of failure.

The surface consisted of a cushion coat, ½-in. in thickness, and a surface of 2 ins., or a total depth of wearing surface of 2½ ins. The usual methods of rolling and finishing were used. The cushion coat was of poorer mixture than the surface and served no useful purpose except that it would have probably proved difficult to rake to an even surface a mixture having so great a thickness as 2½ ins.

This type of pavement was used on all streets, whether of light or heavy traffic, until 1892, except that in 1889 the proportions for the concrete were changed and Portland cement was specified. The proportions were as follows: I part Portland cement, 5 parts sand, and enough broken stone (no bricks this time) to give a surplus of mortar when rammed. In 1892 the popularity of the asphalt pavement become very apparent, but the cost, which was upwards of $4.00 per sq. yd., was prohibitive; so a new pavement for light traffic streets as designed, which reduced the cost to about $2.50 per sq. yd.

This light asphalt pavement consisted of a 4-in. concrete base, with a 2-in. asphalt surface. No cushion was used in the construction of this pavement. In 1895 the possibilities of the light asphalt pavement became very apparent, for in that year the light pavement was used on all residential streets. The specification became standardized, and the price had been reduced to about $2.00 per sq. yd. The concrete was composed of 1 part cement, 3 parts sand and 6 parts stone. The surface was 2 ins. in thickness, with no cushion or binder. From 1895 to 1910 the light asphalt pavement was the standard for residential or light traffic streets, the only change occurring in 1901, when the proportions of stone, sand and cement in the concrete were changed to 1:3:7.

During this interval by far the greater part of the yardage of asphalt pavements laid in the city was of the light type; and, generally speaking, it has given the greatest satisfaction. The price of this pavement was at one time as low as $1.30 per sq. yd., caused by an epidemic of price cutting, but a fair average during this time would prabably be $1.75 per sq. yd. The guarantee varied from 5 to 10 years. To-day there are many of these pavements that are out of guarantee and that are giving good service; and the repairs required annually are not so serious as to render it necessary to resurface the streets.

The popularity of this type of pavement, however, led to difficulties, and in several instances this type of construction was used on streets that were of residential character at the time the pavement was laid, but, due to the good pavement and the changed character of the district, a much heavier traffic reached the street than was anticipated, with the result that the pavements failed either on the surface or in the foundation a few years after they were constructed. These mistakes in judgment, together with the advent of the high speed motor truck, led us in 1910 to discontinue the construction of the light pavement altogether.

In 1908 a medium type of pavement was introduced to provide for those strets that were not entirely residential, and on which it was considered that heavy traffic might occur in the future. This was an effort to provide a cheap pavement for all classes of traffic and at the same time to prevent a recurrence of the trouble referred to above in connection with the light pavement.

This pavement consisted of a 5-in. foundation of 1:3:7 mix, 1-in. of binder and 2 ins. of surface. In

1910 this type was substituted for the light pavement and became the standard for all streets except those in the downtown district or those upon which there were street-car lines.

Turning now to the heavy pavements, we find there was little or no change from 1888 to 1900 with the exceptions noted above in regard to changes in the proportions for concrete. In 1900 the cushion coat was abandoned and a binder coat ¾-in. in thickness was substituted, with a surface of 1¾ ins. The binder provided a better mechanical bond between the asphalt surface and the concrete foundation, and it was also supposed to prevent the absorption of moisture from the concrete, causing the pavement to deteriorate from below. In 1903 another change was made in the surface. The total depth of surface was increased to 3 ins., made up of 1-in. of base and 2 ins. of top. From 1903 to 1913 the heavy pavement consisted of 6 ins. of 1:3:7 concrete, 1-in. of binder and 2 ins. of surface. In 1914 the binder course was increased to 1½ ins., the surface remaining at 2 ins., and what is termed a "close" binder was specified instead of the open binder formerly used.

The open binder was composed of ¾-in. stone coated with asphalt, with little or no fines, while the close binder is made of graded stone with sufficient fines added to at least partially fill the voids.

The close binder was adopted for two reasons: first, on account of the difficulty in getting the open binder to stay in place during the process of laying the surface, and second, it was considered that a better surface could be produced by using a binder that was at least partially filled to start with.

Towards the close of 1914 the depth of concrete used on streets with track allowances was increased from 6 ins. to 8 ins., as it was thought that the heavy impact stresses caused by large motor trucks with steel tires were likely to cause failure of the narrow strips of pavement alongside the rails, as it is quite impossible, under present conditions in Toronto, to get any reasonable distribution of traffic on the streets where car tracks are constructed.

Methods of Repairing Brick Pavements After Street Openings*

So much of the mechanism of a modern city lies under the surface of its streets that the question of street repair is scarcely less vital than that of good original paving construction, if streets are to be constantly serviceable. The excavator is the worst foe of any pavement, and the efficient repair man is its best friend, and will be so long as sewer, water, gas, telephone, power and steam lines are laid in conduits or trenches.

Foresight will lessen the number of openings that it is necessary to make in a completed pavement, but no pavement is ever laid in a growing town without the certainty that it will be disturbed from time to time. In Cleveland, where we have a preponderating mileage of brick streets, it has been necessary to work out careful methods for the replacement of brick paving that has been disturbed. While the process calls for workmanlike exactness, we pride ourselves on patching brick streets so that their strength is unimpaired, and, in many instances, so that the patch cannot be noticed by a casual observation. This is more than can be said for some other forms of pavement.

Our first precaution is to have the city re-lay all the disturbed pavement. Service corporations and other private concerns are permitted to make openings in streets upon filing proper application. With this application must come a deposit sufficient to cover the cost of replacing the pavement. The city inspects the methods of excavation, and particularly dictates the methods of backfilling. But when it comes to the actual re-paving no one but the employees of my department are entrusted to do the work. The cost is deducted from the deposit, and the balance, if any, is returned to the party making the excavation.

I am a firm believer in the policy of compelling the return of all excavated earth to the trench. Only in case of rock excavation would I make any exception. It may be argued that the pipe or conduit takes up a certain amount of space and that therefore a corresponding volume of earth may be left out of the trench. But experience shows that, by tamping, more earth can always be returned to a trench than was removed from it, and the practice of requiring it all to be returned leaves no pretext for spongy backfills, which are a dangerous menace to the security of any pavement.

In replacing a brick pavement over a trench we adhere closely to the original specifications used in constructing the pavement, levelling the subgrade and laying successively the concrete base, the sand cushion and the brick.

The joint of the completed patch with the original pavement, must be, of course, in the original serrated pattern. In making the cut through the pavement sometimes alternate bricks will be broken in the middle, leaving a series of broken bricks along the edge of the cut. These half bricks must be "toothed" out with a chisel. We use one about 18 ins. long, so that none but whole bricks remain. It is then possible to break joints in patching. A patch which does not dovetail into the original pavement, but leaves a long straight longitudinal joint between patch and pavement, cannot be condemned too strongly.

I may remark that a long-handled chisel is the best instrument to use in making the original cut in a pavement. After an opening has been broken with a maul the chisel can be used to cut and pry out each brick separately, making a cleaner opening and facilitating the patcher's job.

Matching brick for the patch is an important matter. If the color and size coincide with the original pavement, the patch will be scarcely noticeable. The brick should be carefully measured in matching for size. Where the new bricks are a hair's breadth thicker than the old ones the courses are thrown out of series and good joints are impossible.

The proper compacting of the sand cushion presents a difficulty that is not found in new jobs of paving. Probably sand has been lost from the original cushion during excavation, and it is necessary not only to compress the sand cushion downward in marking the repair, but to force it laterally under the edges of the old pavement. For this purpose we use a form of sand rammer, consisting of an iron handle 6 ft. in length, with a rectangular head turned at an angle of 45 degrees from the line of the handle. This compacts the sand at the edge of the cut, and an ordinary wooden rammer or a narrow hand-roller does the same service for the width of the patch.

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*By P. J. Masterton, Superintendent of Street Repairs, Cleveland, Ohio, in Good Roads.

Grouting must be done with care and exactness, two to four applications being swept into the joints, and the brick swept clean at the last application. The remaining part of the task is simple precaution against disturbances while the grout is setting. The patch should be covered with three inches of moist sand and barricaded for a period of ten days or two weeks. It is a good extra precaution to barricade the entire street, where conditions permit, and thus avoid the jar of passing vehicles; but this is rarely possible on the ordinary busy street, so the best that we can do is to keep traffic off the patch during the period of setting.

These were the methods used in replacing over 42,000 feet of pavement last year. Our department deals with many kinds of pavements, and while there are others upon which superficial repairs can be made more easily and promptly, there is none in which the original strength of the pavement is restored more fully than in a brick pavement when there is due care in the workmanship and a careful selection of materials.

The Importance of Maintenance in Road Work

By Major W. W. Crosby*

THE importance of proper maintenance cannot be over-estimated. In the older European countries its importance is fully appreciated, and the reputation for good roads that some of these countries enjoy rests upon their careful and efficient maintenance work.

It seems strange that in this country the extravagance of the neglect of proper maintenance has not attracted more attention. It is a well-known fact—or it should be—that the neglect of maintenance increases the amount of deterioration out of all proportion to the time involved, and, therefore, correspondingly increases the cost of repair. In other words, if a newly built road without maintenance will require $100 for repairs at the end of the first year, at the end of the second year it will require, not twice that amount, but more than twice that amount; at the end of the third year, not three times $100, but something like $1,000, or even more. At the end of five years, the bill for putting the road back into good condition would be, not $500, but more likely $2,500. If, on the other hand, $100 would have put it in good condition at the end of the first year, and this $100 had been expended properly, then another $100 would have been required at the end of the second year, and at the end of five years $500, not $2,500, would have to be expended.

Major Crosby.

There is no question but that the same system of constant care over the roadbed as is adopted by the railroads is the most economical for highway work. As a general thing, the construction and maintenance work of the railroads of this country has been performed efficiently and economically, and it is reasonable to assume therefore that the constant, careful maintenance of railroad tracks and other properties is considered by the railroads as simply good business and that their judgment in the matter is worth respecting. Why then should exactly the opposite view apparently be taken by highway authorities?

Where highway maintenance has been attempted to some extent two schemes have been adopted quite generally, and probably the bulk of the maintenance in this country has been carried out under one or the other of these. One is the assignment of a more or less definite section of a public road to an individual for maintenance. This man is credited with a limited fund, and in general is left to his own devices for performing the work, for selecting the time of its performance, and for its quality. In the majority of cases the result has been a failure, and the reasons for such a result are the natural ones. In the first place, the man is selected usually on political grounds, and not on the ground of economy and efficiency. In the second place, when a selection is made with the intention of picking the best possible man for the place, the lack of definite agreement as to what work shall be done and how and where it shall be done results in the performance of the work when it best suits the man having it in charge.

In the other scheme of so-called maintenance, a man is selected to take charge of the work in a considerable portion of the area covered by the central authority, and there is placed to his credit a limited but often fairly large sum for carrying on the work. In some cases he receives no salary, or only a nominal one. The statements made concerning the selection of the man under the other scheme apply equally well under this. Even in the event of the selection of the proper man for the work and the payment to him of a proper salary, the conduct of the work in most cases is uneconomical, inefficient and unsatisfactory, because the usual way of performing it is to get together a gang of men and teams and start out, either before the time for farm work in the spring, or after the harvest in the fall, and, taking the roads consecutively, to attempt to do all the work for the year at one time, and that time a short time. For the balance of the year the roads get no attention at all; the repairs are intermittent and irregular, instead of constant, regular and careful.

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*Consulting Engineer, Baltimore, Md.

A man cannot run his farm and at the same time give proper attention to the maintenance of several miles of highway, because the demands of the two kinds of business are bound to conflict. The one exception to this is in the matter of the log drag; the farmer can do valuable work on the road with this implement, and he can use it to the best advantage when weather conditions are such that a team can well be spared from the farm work.

The reason for the neglect of our roads is that construction has been allowed or encouraged to interfere with, and prevent, proper maintenance. In any new country the construction of roads of some kind or another is one of the first necessities, and in a country as large as this it has been impossible, of course, to build all the roads demanded as fast as they were needed; and it has also been impossible to replace one form of construction by another more suitable to the rapidly increasing traffic when the need for such reconstruction became evident. As a consequence road authorities, with the limited funds at their disposal, have been obliged to devote their energies largely to new construction, and to neglect, to some extent at least, the maintenance of the roads completed earlier. In addition, the difference between unimproved paths which had developed into roads through the amount of traffic over old trails and the improved roads—even though the latter had fallen into a deplorable condition through neglect—was so great that the public demand was for further construction rather than for the restoration of the deteriorated earlier construction. Well stoned roads, even though worn into holes and most unsatisfactory at certain seasons, were so much better, in the opinion of the public, than the unstoned roads that there was a demand for further stoning rather than for the repair of roads already stoned—at least until the latter got to be nearly impassable.

Again, the organization of a locality's forces has usually been at fault in the neglect of maintenance. Those in charge of road work have generally had under their jurisdiction both construction and repair. The requirements of maintenance work demand the prompt and careful performance of little things, persistence and continuity of action, good judgment and craftmanship in actual work, and a high regard for economy. Maintenance work includes far less of the spectacular than does construction. On the other hand, the problems of construction are interesting and relatively short-lived, demanding spurts rather than long-winded action. Among human beings in this country the men of the bulldog, tenacious type in effort are less common than those keenly interested for the time being and capable of short spectacular dashes at high speed. For this reason there has been in the road departments a lack of interest in maintenance work and a tendency to neglect it for the more interesting work of construction.

With the advent of the modern road and the realization of its high first cost there has been an awakening to the desirability of securing as much good as possible from the initial outlay and to the only means of securing the most good—i.e., through the proper maintenance of new construction. The subject of maintenance therefore is beginning to be discussed as much as the subject of construction. As a matter of fact, construction itself is generally subordinate to maintenance. Maintenance needs construction for its being. In other words, a thing cannot be maintained until it has been constructed. What determines the character of the road surface to be constructed? Is it not consideration of the cost of maintaining the best surface possible under traffic? And is not the selection made because one surface will be more easily and cheaply maintained and more satisfactory in service?

The first necessity in the maintenance of any kind of road is to prevent damage by water. An earth road must be kept crowned, so that water falling upon it will not remain on the carriageway, but will be shed to the sides and then disposed of in such a way that it will not be absorbed by the roadway or its foundation. The best and cheapest means yet devised for crowning and keeping the roadway in condition is the continuous proper use of the log drag. This implement will be found useful and economical in the maintenance of any roadway with earthy or gravelly shoulders, even if the road has a centre strip of as hard a material as concrete. The next thing of importance is to see that the water courses along the road and under it are kept open. Obstructions, such as earth, leaves, brush, etc., must be prevented or removed promptly if washouts and other results expensive to correct are to be avoided.

Having taken care of the water, the next thing is to repair and care for the road surface, so that it will remain as impervious as possible to water and as even and homogeneous as practicable under the wear it has to sustain. The log drag is the best means for obtaining these results on an earth or soil road, and it will also be a great help on a sand-clay road. As the road crust grows harder the use of the drag must give way to hand labor with a pick, rake, shovel, and perhaps a tamper. If, for instance, a small depression that holds water appears on a gravel road, it must be repaired promptly if a serious hole is to be avoided. If the bottom of the depression is tight and firm, the material should be picked loose for an inch or so in depth. If, on the contrary, it is loose, clean out the loose material until the edges of the hole are nearly vertical, and then put in fresh material, tamping it well and covering it with finer sizes so as to aid in compaction. For repairs always use, as nearly as possible, the same material as exists in the adjacent roadway.

Broken stone roads, in the main, should be treated in the same way. Sometimes both gravel and broken stone roads show a tendency to ravel in dry seasons. If the effect is due merely to dryness, one of the best remedies is to apply a thin layer of sand (not over ¼ in. thick) before the ravelling has gone too far. The surface will then quickly tighten up under traffic. Do not use clay. If this application of sand is delayed until the ravelling extends an inch or more below the surface and generally over the whole road, it will be necessary to use a roller and water to restore the surface to the proper condition.

All these things are little things, but in order to prevent large expenditures for repairs the little matters of maintenance must be attended to promptly and efficiently.

Construction problems will undoubtedly be presented for solution and discussion, more or less intermittently, for years to come, as changes in traffic occur and as the knowledge of the science of road building develops. Maintenance problems should and will be discussed continuously for an indefinite future. They are affected by traffic conditions, by new solutions of construction problems, and by changes in social conditions. Their importance is increasing, and the general appreciation of their importance is increasing also. For the next few years, at least, this appreciation cannot increase too much or spread too widely, for we are behind in making a start in the matter.

The Design and Construction of Buildings for Industrial Purposes

TO the factory architect are offered many great and absorbing problems, and only in the case of prohibition through cost are we ever supposed to be confronted with the impossible. Somehow or other we are called upon to meet various conditions and develop them upon the lines required for the undertakings we are engaged upon, and if we accomplish this, as a rule the ultimate forms are left to us to deal with without restraint.

The middle of the nineteenth century probably saw the greatest activity in factory undertakings. These buildings throughout the United Kingdom are familiar to us all. All of much the same type of design, somewhat dull and uninteresting, but always of a solid, heavy type, as reflecting the character and solidity of the businesses carried on therein, they stand to this day, still performing useful work. As a rule they are constructed of local material, but in none of them did it appear as though any very great thought had been expended upon the convenience of the employees.

The most marked change between the early factories of the nineteenth century and the present time is not only due to the better housing of the employees, but to an entirely different mode of construction and material employed in the buildings themselves. The older factories were of small spans as regards covered area, with wooden roof principals and floor beams, and with more or less adequate fire-escape arrangements. Timber was the usual and practically the only material to bridge large spans; bricks and mortar the usual wall construction; slung floors were usually of timber; special beams cast iron, columns of the same metal.

I hardly think my subject entitles me to consider the works site, but I should like to say a word on the question of the widths of roadways dividing the factory buildings. In so many factories these are to be found of varying widths from 26 ft. to 40 ft. Such spaces seem to me totally inadequate for present-day requirements, especially where sidings run through these roadways. There are undoubtedly occasions when as much as 200 ft. between factories is not too much. The average works cannot face the loss in acreage that would be the result from a width of 200 ft., but I would like to fix a minimum of 100 ft.; and should this space at first not be wholly occupied by sidings, power mains, etc., the space between the paved roads can be sown with grass until the time arrives when this space is demanded for traffic or other works equipment; and we cannot overestimate the value of these wide roads as fire screens.

Classification

The various buildings comprising the usual factory undertakings may be roughly stated as follows: office and administrative department; raw goods stores; general factory buildings; warehouses for finished goods; power plant buildings, including boiler house, etc.; attendant and by-product buildings.

Our aim in the planning of such a factory must be the arrangement of these various buildings, and the departments comprised in each, in such order as to ensure the passage of the raw materials, entering from one, two, or more sources of supply, through the successive shops until the goods reach their final state, and are stored in the warehouse for distribution to the customer. This passage of the articles under manufacture must, if possible, be arranged without reentering or recrossing departments through which in course of manufacture they have previously passed. Such a process in many cases means a simple arrangement for passing the goods from one side of the building to another or from the top of a many-storied building to the bottom; but in factories where the goods are partly manufactured or handled in the various shops and completed or assembled in others, the scheming to bring each department successively within touch of the other requires care and thought in planning, and for this purpose it is essential for the architect to make himself generally acquainted with the process of manufacture in each case.

The administrative department is a departmental office concerned in the management of the factory itself, and generally includes the following:—Time and wage office, cloak-rooms, bathrooms and latrines, clothes drying-room, rest-room, surgery, manager's and clerks' offices. This block must be placed at a point most convenient to the factory building it serves, and in such a situation as to allow of the rapid distribution of the workpeople to the several departments in the building. Such position may be either the corner, the side, or in the centre, and as far as possible arranged so that the workpeople can reach their own particular work by galleries or passages without traversing the floors of a shop in which they are not engaged. The relative position of the administrative block with the works entrance is not of importance, except that where possible sidings should not have to be crossed by the employees.

In factories made up of a large number of large isolated buildings, or in single factories covering a considerable area of ground, it is desirable to divide and duplicate the administrative department. In plan it should include a large assembly vestibule, out of which opens the wage and time-checking room. This vestibule provides proper accommodation for the workpeople to congregate under cover during the few minutes taken in signing on and on leaving the factory, and also during the time when the wages are being paid. Opening from this vestibule are the cloakrooms, with lockers for each individual employee. In factories where the hands number some hundreds, an attendant's office will be necessary, and this should be placed in full command of the cloak-room and other offices opening from same. The duty of this attendant will be to check the times in and out during the working hours, and be generally responsible for the cleanliness of this department.

The latrine buildings should have the walls of white-glazed bricks, and partitions carried some inches from the ground, and to a height of 6 ft. or 6 ft. 6 ins., plain unmoulded doors, tiled floors laid with proper falls to gulleys, so that the buildings can be thoroughly cleansed with a hose pipe. Opening from the cloakroom should be the bathrooms; these formed usually as shower baths, with simple arrangement for hot and cold water supply, the shower enclosed in a small partition, off which is a small dressing space.

The style of manager's office (and, if necessary, the clerks' office) will depend entirely on the system of departmental management of the particular factory. These rooms where possible should be placed in such a position as to overlook the factory.

There are still two departments required to complete this block, namely, the first aid surgery and the rest-room. For the surgery a small room with tiled walls, tiled floor, having small operating table, couch, medicine chest, antiseptic ointments, bandages, plain splints, with small sink, hot and cold water, electric radiator, and electric kettle.

The other so-named luxury is the rest-room. These rooms are required only where girl labour is employed, and should be as unlike any part of the factory building as possible. They are used by the workers in cases of faintness and sickness, the girls being granted permission on application to the forewoman of their department, and here are permitted to spend an hour in comfortable, quiet, and restful surroundings. The room is under the supervision of a matron attendant.

Materials of Construction

The following are offered to us for choice:—Brick structure wholly, with wood or cement floors, and with wooden or steel roofs; steel and brick composite buildings, with wooden or slung concrete floors, steel or wooden roofs; steel structure; reinforced concrete structure.

Some twenty to thirty years ago the forms of composite buildings varied very considerably, and were designed in both iron and steel in peculiar forms for each undertaking. Gradually out of this somewhat chaotic state the designs became more uniform; joists, girders, and roof principals were catalogued, and almost all forms of major items in the buildings were carried out in a generally recognized design. Girder connections, seatings, and brackets have been further standardized, and perhaps we are now too well supplied by manufacturers and constructional engineers with catalogues of these details, which, whilst forming a constant and convenient reference, are inclined to check research and enterprise in the way of new forms.

There is another and a newer form of construction that is claiming and demanding very serious consideration at our hands, and that is reinforced concrete. The earlier promoters, for reasons best known to themselves, desired to treat the architect as neither knowing nor wishing to know anything of this science of building. That it is a wonderful science is undoubted, and its ready acceptance on the Continent and abroad has enabled many regions of the world to be brought almost into the heart of commercial life. To my mind, bridge construction, riverside piers, jetties, retaining walls, silo buildings, cooling towers, culverts, and the more peculiar forms, are the lines upon which reinforced concrete finds its particular outlet. One hesitates to accept this form of construction for the average factory, on account of the many changes that are constantly being made, especially as regards machinery. These changes invariably lead to the cutting of floors, rearrangement of loads and points of support, and one cannot get away from the feeling that during these changes the cutting of a main member might possibly mean a partial collapse.

Floors and Roofs

The construction and finish of factory floors is a matter requiring care and experience. To-day we have constantly brought to our notice different forms of floor construction—fire-resisting blocks, patent joists, etc.—but I believe most of us prefer to use the ordinary steel joist and concrete filled floor, and, in special cases, girders with concrete filling, boxed out and strengthened with mesh metal. It is unnecessary to state that the weights of the loads to be carried must be most carefully calculated, so that there will be no straining of the structure, and the surfaces of the floors must be properly prepared to take the finishing necessary for the special class of factory we are dealing with at the moment. These finishings may be roughly taken as follows:—Engine and power stations, hard tile; boiler houses, blue brick; chemical factories, blue acid-proof brick, with acid-proof asphalt; factories, granolithic paving, asphalt and wood blocks.

The roof of a factory is perhaps the most interesting detail we have to consider. I do not propose to discuss the different types of roof principals—these have become practically standardized—but I shall refer to one or two peculiar forms that I have often found it necessary to employ. When called upon to erect a factory in a district with which I am not familiar, I generally apply to the nearest observatory for the records of winds and gales, also for particulars of rainfall. Such information is most readily given, and one has then the satisfaction of calculating all details on a sound local basis. In connection with these observatory details, on two occasions after the factories were completed, the observatories were good enough to write stating that gales had just occurred greatly in excess of any previous record; and therefore, in view of the increased spans asked for, it is desirable that no risk should be run when calculating the strains and stresses for this or any other part of the structure. One must admit that at times roofs and girders give the impression of being extremely weighty, and therefore costly, and perhaps it may be only two or three times in the year that they are strained up to their full load.

The roof of the average two or more storied building is usually a single span of the ordinary type of principal suitable to the width, with probably a certain proportion of skylight area, and in some cases peculiar details as regards louvre ventilation. The lighting of large one-storey areas presents more details of interest. The north and east lights are the steadiest for factory buildings, and the usual type of roof is that known as the Weaver roof, in which the northerly side is wholy glazed and the southerly side slated or covered in some other form.

The angle of the north pitch is a matter requiring careful adjustment and is governed by the situation of the works, either at home or abroad. In England and in dull climates, and on the western slope of a valley, the angle with the horizontal must be reduced to about 60 degs. The slated side will be at a pitch of about one-third the span. This angle of 60 degs. may require to be varied in factories where an unusual amount of ventilation is required. As a rule this ventilation is provided in the form of open louvres framed in the ridge of each roof, and running the whole length from parapet to parapet. These louvres project some 2 ft. to 5 ft. above the ridge. If, then, the pitch of the glazed side is too upright, the outlook from the floor or working level in the shop, and furthest from the skylight, is into this line of louvres, with the result that the shop is unnecessarily darkened. In such a case the pitch of the glazed side of the roof should be reduced, and its exact angle fixed by a trial by diagram. If the shop is one requiring not only ventilation but a very considerable amount of light, the slope of the louvre roofs should also be glazed. The span of these Weaver type roofs varies from 25 ft. to 35 ft. It is worth our while for a moment to consider to what maximum limit of span this type of roof may be taken, so as to be economical as regards construction and satisfactory as regards lighting the shop. Personally, I have no hesitation in taking the span up to 33 ft., but I should call this the extreme limit, and the result in both cases will be quite satisfactory.

So far we have dealt with the span only of this type of roof. The craving amongst manufacturers for large floor spaces with as few supports as possible brings us to the problem of what cross spacing can one economically carry these roofs. Again, 30 ft. to 33 ft. seems to me the economical limit; beyond that special and costly girdering is necessary and is usually arranged as follows: Where the larger spacings bring the points of support parallel with the ridge, the girders are carried above the gutter line and the principals of the roof are framed into the lower plates of these girders; but if the points of support are to be across the line of the ridge, then the girders are formed of a Warren type, with the members following the line of the Weaver roof, in which case both the glazed and slated sides of the roof will be carried through the supporting girders continuously from outside to outside of the factory.

All gutters for this class of roof must be adequate, say 18 ins. to 24 ins. wide, strong cast iron, with rebated joints, and fitted with proper boxed cistern outlets. There is no necessity to have these gutters with tapering cast, as they will clear themselves of water to outlets 50 ft.. to 60 ft. apart, and in case of replacement there is then no likelihood of delay and inconvenience due to the necessity of casting a special taper. If the length between outets is greater than 60 ft. the depth and width of the gutter must necessarily be increased. The gutter outlets are connected to the heads of the columns carrying the roof, which column can be conveniently used as the outlet itself, the column head being arranged so that none of the bolts connecting the roof girders will pass through the head itself, and at the base of the column it will be convenient to cast on sideway outlets, with flanged joints, to connect up to outer bends into the ordinary drain. The core of the column is filled in with concrete to the height of this outlet, and benched off to throw the water outwards. If, as is more usual, stanchions are used as the roof support, downspouts will be carried in the hollow of the stanchions.

For factories of 120 ft. to 150 ft. span, and requiring a considerable amount of light, the following form of roof is being largely adopted on the Continent. The principals spanning the full width are formed as light Warren girders, of a depth between 14 ft. to 20 ft. On both wall sides the whole depth of the girder is glazed, and from the head of the glazing, from one side to the other, concrete flats are formed, but not over the centre one-third of the shop. These flats are laid with a slight fall outwards. The space left in the centre of the roof is then framed as an ordinary pitch roof, glazed on both sides. Such a roof gives an enormous amount of light into the area covered, and if it is used in a shop where ventilation is very necessary, the centre portion of the roof is lifted from the level of the flat on to framed louvres.

I have referred frequently to roof glazing, and in all cases I have had in mind the many excellent forms of patent roof glazing which are turned out by English manufacturers. Most of the patentees have carefully considered and can now with equal facility glaze their bars into timber, steel, or concrete connections, and provide an excellent form of weatherproof glazing even with a pitch as low as one in thirty. Rapidity of execution, easy renewals of broken sheets, and renewals of special parts are not the only advantages. By special arrangement of the bars, one can be certain that condensation will not drop from the roof on to the floor beneath; this is a matter of very considerable importance where the manufacture of certain articles is carried on in shops where a certain amount of free live steam or vapour is given off. Where possible the sheets of glass should not be of greater length than 9 ft., though if required they will be provided up to 11 ft.

Fire Protection

The principles which govern the factory staircase are those which apply to all public buildings, namely, suitability and directness of access. Their position in the works will be governed by a number of considerations, both as regards traffic and purpose, but no circumstances must be allowed to cramp or confine them into out-of-the-way corners. Of a width convenient for the numbers using them—and if this means a greater width along the step than from 7 ft. to 8 ft. the flight must be divided by suitable plain round handrails with strong iron standards, also with plain handrails fixed on the wall side. No flight should be of a greater number than twelve steps, and these not greater than 6 ins. rise or less than 11 ins. on tread. All landings must be full half, and the outlet or doorways at the top or bottom must open into as large a collecting area as possible. In a word, when deciding the position and size of these staircases, one must always have in mind the use of same in case of fire, when quite possibly a mad rush would be made to leave the building. The doors must open out from the staircase; and the flights should be well lighted and ventilated from the sides away from the factory. The materials used for the steps should be either stone or concrete; in some cases slabs of timber, of not less than 3 ins. thick, may be used. Iron fire escape staircases are quite familiar to us all. With these, it is desirable that the risers of each step, so often omitted altogether, should be solid or perforated, to prevent accident to those using the staircases.

One of the most important discussions at the recent annual meeting of The American Concrete Institute Convention was on floors—how to prevent dusting. It appears to be fairly settled that fine material must be absent from the top course. Fairly coarse, hard stone or sand (none of it passing a 30-mesh screen) is recommended, and hard stone has the preference over sand.

Testing Buildings for Settlement During Subway Construction

In order to ascertain from time to time if there is any movement of buildings, elevated columns or other structures along the route as the result of subway work, permanent benchmarks are established on such structures, writes P. M. Entenmann, of the New York Public Service Commission. A good practice is to set all the marks at some even-numbered elevation so that when checking the elevation of the points it is unnecessary to have the original record in the field, as any other than an even numbered elevation indicates movement. A record of the elevations is kept on 8 x 11-in. sheets which give the plan of the building, a description of the benchmark, etc. Whenever levels are taken on a building a record is made on the sheet and the differences are noted. There is a general sheet for each building. A sheet of similar form is used for elevated-railway columns. In addition to fixing the elevation of some permanent mark on buildings and elevated-railway columns these structures are plumbed so that the movements due to construction can be detected. An auxiliary base-line is run close to the buildings and sights are taken with a transit to points on the top and bottom of the structure. In the case of buildings, marks are cut on the wall as near the roof and as near the sidewalk as possible, and sometimes at intermediate points, and a record made of the reading from these points to the auxiliary base-line. Movement of the building as a whole as well as any change in inclination can then be detected. In the case of elevated-railway columns, marks are cut at top and bottom and readings are taken to the auxiliary base-line, and also to a line at right angles to this line at each column, so that movement in any direction can be observed. These records are kept on 8 x 11-in. sheets similar to the ones for settlement levels. Prior to beginning construction work, an examination is made of each building which might be affected by the work. A report is made of the condition of each room of the building describing all the defects in the walls, ceilings and all ordinary conditions which might later be attributed to subway work, and in addition a similar record is made of the condition of the exterior, the cellar and the roof.

Depositing Concrete in Deep Water Through a Pipe

Writing on "Deep-water Concreting through a Tube," in Concrete and Constructional Engineering, Mr. E. B. Von de Greyn says concrete deposited in deep water through a pipe should be of a mushy consistency in order that it may flow easily after leaving the end of the pipe under the surface of concrete just previously deposited; it will then spread more evenly after leaving the pipe, thus avoiding the formation of hillocks and making it unnecessary to change the position of the tremie in a horizontal direction as frequently as would be the case if drier concrete were used. Also it will not choke the pipe. A little experimenting at the outset will soon indicate how much water should be used in each batch. After the proper amount is determined it should be regulated by a gauge so as not to vary, consideration being given, of course, to appreciable changes in the amount of moisture in the aggregate. Mushy concrete deposited in water shoud have an excess of cement. There is a loss of cement due to the excess water in the concrete finding its way out and carrying a portion of the cement, which is found in the laitance on top. A 1:2:3 mixture is recommended.

Requirement of 12-in. Curtain Walls

Twelve-inch curtain walls in steel skeleton construction are to be made possible by a revision of the New York building code section dealing with masonry construction. This section has been revised in the course of the general code revision, and will shortly be laid before the Board of Aldermen for adoption as an ordinance. One of its important improvements over the old code is a clause permitting the use for the full height of the building of 12-in. curtain walls in steel skeleton structures where the walls are supported at each floor by the steelwork. The present law requires a considerable increase of wall thickness in the lower storeys, in spite of the fact that the wall does not carry itself. The revision also recognizes terra cotta as a permissible facing equivalent to ashlar. Hollow building blocks of terra cotta may be used in the construction of walls in buildings less than 40 ft. high. A provision for rubble-stone walls is added: these must be 4 ins. thicker than brick, stone or concrete walls, and at least 18 ins. thick, but in all events limited to 60 ft. in height.

Novel Use of Electric Fans

Ventilating fans were employed at Cleveland, Ohio, to force a fire extinguishing compound through underground ducts containing burning cables. Exhaust fans were installed at the opposite end of the duct run to remove the highly inflammable gases which were produced by the volatilization of the rubber and paraffin insulation. It was not until after the cables had burned several hours, however, that this novel use of electric fans could be made, as the burning gases issuing from the conduits prevented men entering the manholes. While the underground cables were being replaced emergency service was furnished through temporary aerial conductors.

Samples of radium-bearing ore from British Columbia have recently been examined by the Mines Department of the Dominion of Canada. The quantity of radium contained in the ore has not yet been announced, but the examination is said to have revealed sufficient radium to make the test of special importance. Magnetite is one of the minerals regarding the possible production of which in Canada the Department has been asked to report, since the supply from Europe is cut off. The very best magnetite is known to exist in British Columbia in large deposits, but they are at present too far from transportation routes to make mining and working the ore practicable or profitable.

The New York Central Railway Company has in use twelve pneumatic ballast-tamping machines supplied by the Ingersoll-Rand Company. Each unit consists of a portable petrol-driven air compressor and two tampers, and can deal, on an average, with 140 sleepers in a day of 5½ hours. The cost per hour, with petrol at 20 cents per gallon and gas engine oil at 40 cents per gallon, was found to be:—Petrol, 32.6 cents, oil 1 cent, labour 34 cents, total, 67·6 cents.

The quantity of cement should invariably be regulated by its weight. If the proportions are stated by volume, a definite weight or number of packages of cement must be assumed to the unit volume.

The Englehart, Ont., Water-Works

(Contributed)

ENGLEHART is a thriving town situated about one hundred miles north of North Bay. The country in which it is located has been regarded until quite recently as nothing but a forest, but its development in late years has been noteworthy. Englehart was incorporated in 1908, and today it has a population of over a thousand people, with an assessment of some two hundred thousand dollars, exclusive of T. & N. O. lands.

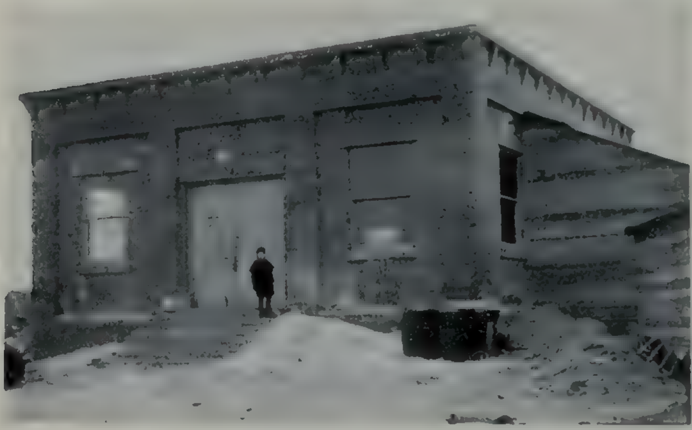

Fig. 1—Pumping station, Englehart water-works.

The Temiskaming & Northern Ontario Railway Company have their divisional headquarters at Englehart, and their shops and roundhouses give the town an additional element of industrial activity. Electrical energy is furnished the town from the water development at Charlton.

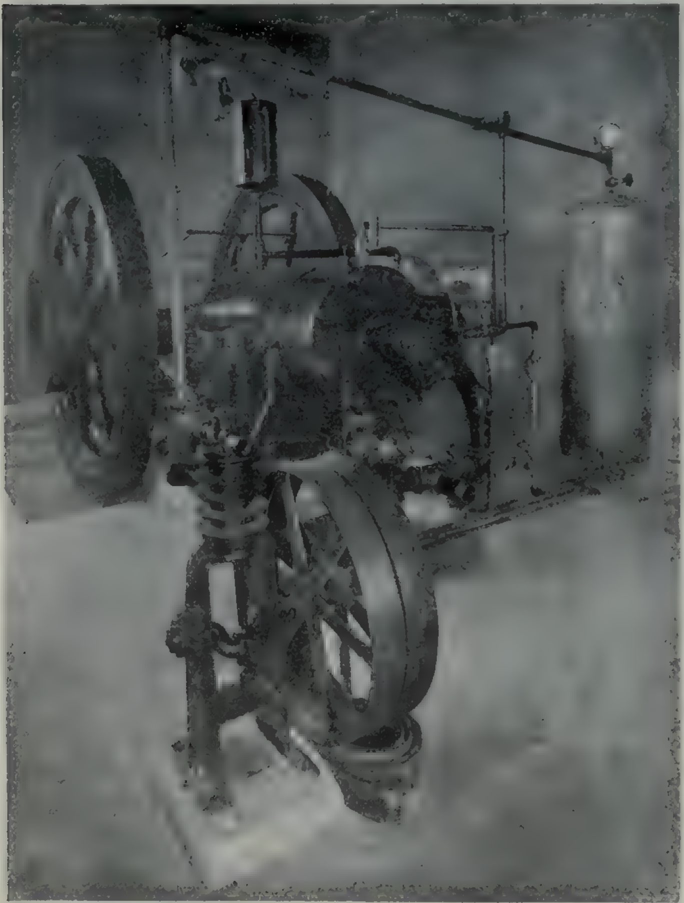

Fig. 2—A 70-h.p. Fairbanks-Morse "Quick Start" oil engine with belted air compressor.

During the last two years the corporation have added their best asset in a modern domestic water-works system with a fire-fighting reserve. The plans for this system were prepared by Messrs. Sutcliffe & Neelands, who also supervised the installation. It must be borne in mind that conditions and temperatures in this northern climate call for protective measures which are quite unnecessary in other parts, and it is noteworthy that the operation of the system has been most satisfactory.

Distribution mains at a depth of eight feet extend through the business and residential section of the town, with provision for coupling on new areas that are rapidly building up. Fire hydrants are located at frequent intervals. The pumping station, illustrated herewith, is built entirely of concrete, and when cleared of construction material will present a very attractive appearance. The pumping machinery was built and installed by The Canadian Fairbanks-Morse Company, Limited, of Toronto. The combination is somewhat original and is worthy of note, since the oil engine, hitherto considered unreliable, is used exclusively for the domestic supply, as well as for the fire-fighting unit. Fig. 2 shows a 70 h.p. Fairbanks-Morse "Quick Start" oil engine of the type "NB" construction. Note the starting apparatus, consisting of a belted air compressor and a vertical air retainer. A pressure of 100 to 120 lbs. is held in reserve for instantaneous starting. As an auxiliary (in the event of an air leak) the engine is fitted with the firm's patent hand starter pump, a combination which insures a "quick start" in the event of a fire. It will be noted that no stand-pipe pressure is available. The outfit burns a low grade distillate and operates on the throttling governor principle. Gear-driven magneto is used for ignition and a gravity oiling system takes care of the lubrication in an improved manner. Power is transmitted to the two-stage fire pump (shown in Fig. 3) through an oil-immersed helical gear box carried on a cement foundation with a metal housing. "Skefko" ball bearings are mounted on each side of the driven gear to reduce friction and prevent end thrust. In Fig. 3 can be seen the friction clutch, which allows of starting the engine under "no-load.". The pump is designed for a capacity of 600 Imperial gallons against 280 ft. head, and runs at a speed of 1165 r.p.m., the engine speed being 210 r.p.m. An extended bedplate with coupling is provided for motor auxiliary

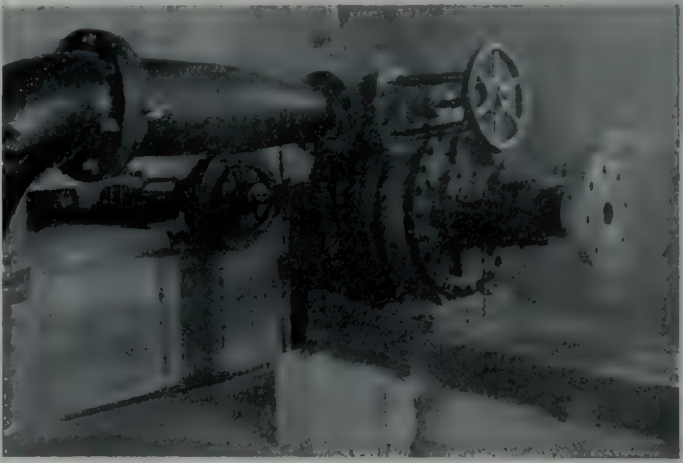

Fig. 3—Two-stage fire pump.

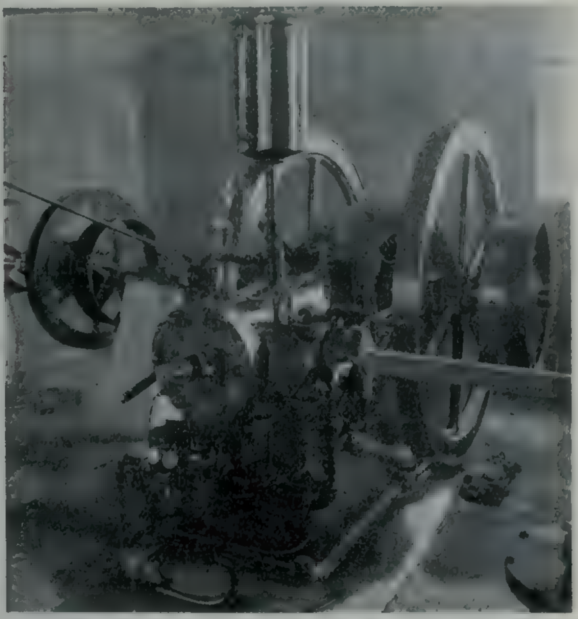

Fig. 4—A 15-h.p. Fairbanks-Morse engine, driving the deep well pump.

connection at a later date. A rising spindle gate valve is provided to relieve the pump from domestic pressure when idle. Fig. 4 shows a 15 h.p. Fairbanks-Morse engine of a design similar to that described above. This unit takes care of the domestic pumping and drives the deep well pump. It operates continuously with splendid economy, day and night. A friction clutch is mounted on the engine shaft for ease in starting. Adjacent to the clutch is a cement pier carrying a ring oiling pillow block for steadying the pump pinion shaft. A 24-in. iron sheave is mounted on a friction clutch, which drives the well head by means of a wire cable. In Fig. 5 there is seen a 7 x 10 in. Goulds Triplex single acting plunger pump, designed for a capacity of 250 Imperial gallons per minute against a pressure of 50 lbs. It will be observed that either the domestic pump or the deep well pump can be operated independently or together. A sliding pinion is provided on the Triplex pump to make this possible. Pressure on the mains is controlled by an excellent device partially shown in the illustration. Directly off the pump discharge is a branch of 2½-in. pipe leading into a Mason Regulator. The discharge from the regulator is piped around to the suction side of the pump, as shown. Back of the check valve in the discharge to the main is an opening which is piped to the pneumatic tank or air chamber, shown in the corner of the building, and from the same outlet a small pipe runs to the diaphragm of the regulator. On the arms shown are placed sufficient weights to counteract the pressure against which it is desired to pump—in this case 50 lbs. When the pressure runs up in the main—due to absence of water-takers—the small pipe leads the pressure over to the diaphragm or plunger of the regulator and forces it open, which allows the pump to run under practically no-load until such time as the main pressure is relieved and the regulator comes back to the closed position. This device is known by the manufacturers as 'Form "L" Control.'

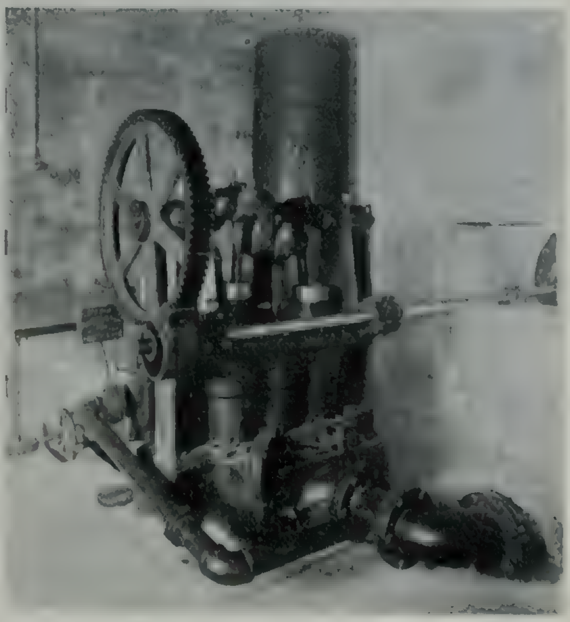

Fig. 5 A 7 in. x 10 in. Gould's triplex single-acting plunger pump.

The deep well unit is situated about 100 ft. from the pump house, and is driven from the pinion shaft by a friction clutch sheave. The transmission cable is ⅝ in. in diameter, and is guided to the head by a universal mule-stand, the well location being at an angle from the drive. The head is a "Goulds" Fig. 1030, using single gear, machine cut. The "A" frames of the head bring the crank-shaft about 6 ft. from the ground-level, which permits of a 24-in. stroke. The working barrel used is manufactured by the W. B. Erb Company, of Chicago, and is by far the simplest double acting cylinder we have yet seen in operation.

Water is taken from a depth of about 70 ft. and forced a horizontal distance of possibly 100 feet into an underground reservoir built in the form of an inverted umbrella and roofed with reinforced concrete.

Build Now!

Extremely low bids have been a feature at many lettings this spring. In fact numerous contracts have been taken at prices that seemingly allowed a dangerously small margin between profit and loss. When the successful bidder on a $300,000 job is $75,000 under the engineer's estimate and $50,000 lower than his nearest competitor it is reasonable to conclude that some one has made a mistake in his figures. But when this same thing happens time after time it begins to look as though half the contracting profession was bidding wild. Mistakes, of course, happen frequently, but all the extremely low bids at recent lettings cannot be ascribed to errors in the estimates. It would seem rather that the bidders in their eagerness to secure work are willing to take long chances. Neither has it been the inexperienced contractors that have been submitting the low bids. In fact some of the best known firms in the country have taken jobs at prices that seemed ridiculously low as compared with those of previous years. Of course, many contractors are bidding on work at the present time with the sole purpose of keeping their organizations intact and their outfits busy until jobs more to their liking develop. But there is no good reason why this work should be taken at prices that mean a big loss.—Engineering and Contracting.

The New Building of the Standard Bank at Vancouver

THE new Standard Bank Building at the corner of Hastings and Richards Streets, Vancouver, enjoys the distinction of being one of the city's highest structures, as well as one of the finest modern office blocks on the Pacific coast. It was erected by a company organized by Mr. J. W. Weart, and was designed and constructed under the supervision of Messrs. Russell, Babcock & Rice, architects, of Vancouver. The cost complete ran into $450,000. The general contractors were the Canadian Ferro-Concrete Company, Limited.

The structure is a steel skeleton frame, every portion of which is enclosed in concrete. The floor slabs are of concrete, reinforced with cold twisted bars—a type of construction in which the general contractors specialize. The foundations are carried down to bedrock, and the basement is thoroughly waterproofed.

The Standard Bank Building, Vancouver.

Vancouver now has a by-law which restricts the height of buildings to ten storeys, but the permit for the Standard Bank was taken out before this measure became law; so that the tenants of the five upper storeys have a unique advantage in the way of an unobstructed view on all sides—with no fear of losing it.

For the exterior the architects have employed tiling manufactured by the Kittanning Face Brick Company, of Pittsburg, Pa. The brick is treated by a special process which renders it impervious to water. Atlas Swan White cement and Monterey white sand were used for pointing the brick.

On each of the upper floors of the building there are thirty offices. Ample hall space is provided on each of the floors.

The three lower storeys are terra cotta, with a polished granite base. The next eight storeys are face brick, and the upper storeys are terra cotta.

The interior finish throughout the building is done in eastern white oak. Each office is fitted with porcelain wash-basins, equipped with hot and cold services. The light fixtures are of special design, and each room has extension wall blocks for desk lights. The building is steam-heated, with controlling devices in each suite.

The floor of the outer vestibule is of cedar Tennessee marble, alternating in pattern with Belgian black. Throughout the building the floors are of terrazzo with marble borders. All the lavatories have a marble wainscotting six feet high. The stair treads are of terrazzo, following the general floor surface scheme of the entire structure.

Elaborate precautions have been taken to cope with the fire emergency, escapes and two sets of hose having been provided for each floor. The windows are of metal, fitted with wired glass on the sides exposed to adjoining property. The partition walls are lined with terra cotta. Elevator shafts are enclosed from the corridors with metal frames with wired glass. The floors are of reinforced concrete over steel beams on four-foot centres.

The mechanical equipment includes a steam heating plant with vacuum circulation, a stand-pipe for fire protection, and five electrically-operated traction type elevators with a speed of six hundred feet a minute.

The sand and gravel used in the fireproofing of the building were supplied by the Ritchie Contracting and Supply Company, Limited, who furnished some thirteen thousand cubic yards of material.

The interior decorating and painting was done by Messrs. C. J. Cummings and Company, Vancouver.

Half a part per million of iron in water is detectable by taste, and more than 4 or 5 parts makes water unpalatable, according to water supply paper 273, recently issued by the U. S. Geological Survey. More than 2.5 parts per million in water used for laundering makes a stain on the clothes. Iron must be removed from water from which ice is made, or a cloudy, discolored product will result. An iron content of over 2 or 3 parts per million in water used in the manufacture of paper will stain the paper. Waters having a high iron content have in some places, where they have been used as city supplies, caused an immense amount of trouble and expense, for they favor the growth of Crenothrix to such a degree that the water pipes become clogged with the iron sheaths of that organism.

Large centrifugal pumps, claimed to be the largest of their kind in the world, were recently installed for use in drainage work in New Orleans. Four pumps were ordered and each had to be capable of raising 168,000 gallons of water per minute at 1 ft. head. The delivery opening is 78 in. in diameter. These pumps will have to work at heads varying from 1 ft. to 13 ft., and whereas they will be able to lift 168,000 gallons of water per minute against a 1-ft. head at a speed of 55 revolutions per minute they will have to be run at 113 revolutions per minute in order to raise 90,000 gallons per minute against a 13-ft. head. A fifth and smaller pump was also put down. The latter had an outlet 48 in. in diameter and was designed to deliver 47,500 gallons of water per minute against a head of 3 ft. At the same head the larger pumps deliver 156,000 gallons of water per minute, so that if all five pumps were worked together their combined capacities would be 671,500 gallons per minute, or, say, 966,960,000 gallons per day.

Mainly Constructional

East and West From Coast to Coast

The Paving and Construction Company of Canada is a new firm registered at Montreal.

The Bronze Company, of Preston, Ont., have secured a $200,000 contract for shells, upon which their plant will have to work day and night.

At Toronto, the building employers have signed an agreement with the Bricklayers' Union for a term of twenty months at a rate of fifty-five cents an hour.

Notable among the permits issued recently at Vancouver is one for a large automobile plant at the corner of Hamilton and Davie Streets. The building is to be of mill construction, 75 by 120 feet in dimensions, and five storeys high.

Messrs. Carter-Halls-Aldinger have started work on the new ten-storey store which is to be erected for D. S. Curry opposite the Winnipeg Post Office, at a cost of $225,000. Messrs. J. D. Atchison & Company, of Winnipeg, are the architects.

The City Engineer's office at Calgary has lost three of its best men. Each holds a commission and all are qualified. Lieutenant and Adjutant W. M. Sage was a civil engineer on the staff; Lieutenant W. M. Brooks was also a civil engineer, and Lieutenant F. Lawson was the architect on bridge construction.

Good progress is being made by the Pacific Lock Joint Pipe Company in the work of fabricating and laying the last section of the concrete pipe on the flow line grade of the Sooke Lake water system, which will supply the citizens of Victoria with pure mountain water. The line will be completed early in May.

An interesting engineering undertaking in prospect is an extension to the sewage and water-works system at St. Joseph de Levis, Que. The work is estimated to cost $150,000, but it is not likely that operations will be commenced before next year. Messrs. Gauvin & Beauchemin are engineers to the municipality.

The contract for the erection of a novitiate for the Christian Brothers at Laval des Rapides, P.Q., has been awarded to E. N. and U. Boileau, of Montreal. The plans, drawn up by Viau and Venne, provide for a three-storey building on a site 81 ft. x 200 ft. It will be of stone and concrete construction, the estimated cost being $475,000.

Tenders have been called for the second addition to the No. 1 grain elevator of the Montreal Harbour Commissioners. Plans have been prepared by the John S. Metcalf Company, Limited, Montreal. The piling contract was awarded to the Peter Lyall and Sons Construction Company, Limited, Montreal. The addition, like the rest of the structure, will be of concrete, and has involved the removal to an adjacent site of one of the offices of the Commission.

The falling off in the contracting business is reflected in the balance sheet of the National Brick Company of Laprairie, Limited, for the year ended February 28 last. The earnings were $139,617, a decline of $119,360. Bond interest absorbed $139,146, leaving net earnings of $471, and as one quarterly dividend of $25,000 had been paid, the surplus had to be drawn on to the extent of $24,529. The contraction in building operations after the boom of 1913 meant smaller sales, keener competition and lower prices for brick manufacture. The stocks on hand are valued at $173,244, which is higher than a year ago. During the past year the plant and machinery have been overhauled.

Estey Bros. Company, 2 St. Cecile Street, Montreal, have secured the contract for the ornamental iron and bronze work on the Sun Life Building, Montreal, now being completed. This firm also have the contract for the ornamental iron work on the St. Denis Theatre, Montreal.

Mr. J. A. L. Waddell (of Kansas City), who has designed many well-known bridges in British Columbia, and who has contributed to The Contract Record, has had conferred upon him by the Japanese Government, through its Department of Education, the degree of Hakushi (Doctor of Engineering). This is the fourth doctor's degree conferred on Dr. Waddell, the three other degrees being Doctor of Science, McGill University, 1904; Doctor of Laws, Missouri State University, 1904, and Doctor of Engineering, University of Nebraska, 1911.

Work has started on the five-storey concrete and terra cotta structure which will be erected at the north-west corner of Portage Avenue and Garry Street, at Winnipeg, and which will be finished by November 1st of this year. The ground floor will consist of stores and the four upper floors will be used as offices. The contract has been awarded to the Carter-Halls-Aldinger Company. The new structure will be known as the "Paris Building." The property was bought in 1912 from Sir James Aikins by a Frenchman from Paris. The site is 88 x 130 feet.

The programme of public works for Calgary, as mapped out by Commissioner Garden and City Engineer Craig, totals $465,500. Including the Nose Creek sewer and the Mission bridge work, for which provision has been made, the total will be about $500,000. The programme of work is as follows: boulevard improvements, $10,500; curb and gutter, $15,000; retaining walls, $10,000; sidewalks, $55,000; sanitary sewers, $10,000; storm sewers, $35,000; paving, $100,000; grading, $60,000; trunk sewers (other than Nose Creek), $30,000; Centre Street bridge (required for 1915), $125,000; water main extensions, $15,000; total, $465,500.

Mr. J. D. McArthur, the well-known Winnipeg contractor, passed through Vancouver recently on his way to California, where he will stay some time, visiting the exhibitions at San Francisco and San Diego. Interviewed in Vancouver as to constructional activities and prospects, Mr. McArthur said, in part:—"The acreage for crops in Western Canada will be far greater than ever this year, and the prospects are most hopeful for a record harvest. The western cities will benefit from the harvest, and the general situation, which is already reviving, will take a great change from the improved conditions prevalent. The increased demand for lumber will benefit British Columbia, and thereby this province will be in a better financial condition. We look for an improvement in the method of raising capital for large enterprises like railway construction with the end of the war, for in financing construction the New York market is not as convenient as London, because in the Old Country the issues are for longer terms than in New York, and the percentage demanded for loans is higher in New York. So far as I am concerned personally, I am busier this year than ever before, with the Hudson Bay Railway contract for the Dominion Government, and the construction of the Edmonton, Dunvegan & British Columbia line. The latter is a personal enterprise."

From New Glasgow, N.S., we learn that the Eastern Car Company has been given an order by the Russian Government for two thousand steel frame box cars, and that the Nova Scotia Steel Company has received an order for shells worth $3,500,000. Work will begin at once on both orders. The cars will be shipped in sections from Pictou Landing to Vladivostock.

At Toronto, the construction of the Bloor Street Viaduct is in full swing, with two hundred and twenty-five men employed. Abutment A has been completed, B and C are well advanced, and work on F has started. Messrs. Quinlan & Robertson, the contractors on the Don Valley section, are pushing the cement work so as to get it completed during the summer. This will allow the steel work to be carried on through the winter, and prevent delay. The time allowed for the contract is three years, but it is hoped to get it done somewhat under that time. The Dominion Bridge Company on the Bloor Street section are also pushing the work to the limit.

Personal Mention

Mr. R. C. Harris, City Works Commissioner of Toronto, is taking a month's holiday with Mrs. Harris at Atlantic City.

Mr. R. H. Thomson, formerly City Engineer of Seattle, has been awarded $15,000 against the Seattle Times in a libel suit for $75,000.

Mr. W. R. Devenish has been appointed Principal Assistant Engineer of the Canadian Government Railways, with office at Moncton, N.B.

Mr. G. W. Northwood, a Winnipeg architect, who went to the front as a captain in the 90th Regiment, has not been heard of since the battle of Langemarck.

Mr. D. B. McIntyre, Superintendent of Construction and Maintenance of the Montreal Electrical Commission, has resigned. He has accepted a position in New York.

Mr. S. Beresford, Winnipeg, representative of the Canada Cement Company, has returned to the western metropolis after a visit to Montreal and other eastern points.

Lieut. Henry Lloyd Owen, a native of Pwllhli, Wales, reported missing in a recent casualty list, is a Moose Jaw architect who has done considerable work in Saskatchewan.

Mr. Leon Archibald, a civil engineer of Regina, formerly in the employ of Messrs. Reilly, Dawson, Hancock & Reilly, of that city, is among those reported wounded in a recent casualty list.

Mr. V. W. Horwood, Provincial Architect of Manitoba, underwent an operation at Rochester, Minn., recently, and is reported to be progressing fairly well, although a second operation will be necessary.

Mr. R. H. Thomson is to bring the work in Strathcona Park on Vancouver Island to a close this summer pending the end of the European war. After July 1st, it is stated, he will open an office as consulting engineer in Seattle.

Mr. W. A. McLean, Chief Engineer of Highways for the Province of Ontario, has been asked to preside over one of the sessions of the Pan-American Road Congress at the Panama Pacific International Exposition at San Francisco next fall.

Mr. A. P. Linton, of the Saskatchewan Highways Commission, read a paper descriptive of the new traffic bridge at Saskatoon before a recent meeting of the Regina Engineering Society. The structure was described briefly in our issue of February 10th last.

The Montreal Board of Control have extended the leave of absence of Major G. Janin, the chief engineer, and Mr. M. Basset, assistant engineer in the public works department, who have gone to the front. Word has been received that Major Janin and his corps of engineers have arrived in England, having sailed on April 19 from Halifax. Major Janin and Mr. Basset now have leave of absence until September 1, the salary of the former being placed at $3,000 per annum, instead of $9,000. It is understood that the Montreal city engineering department is to be reorganized at a little later date.

Mr. James A. Farrell, President of the United States Steel Corporation, passed through Winnipeg recently on his way to Banff, Vancouver and San Francisco. Interviewed in Winnipeg, Mr. Farrell expressed the view that the United States was emerging from a long period of depression, and that the country was on the eve of a new era of constructional and general activity. Mr. Farrell is an interesting personality. He is fifty-two years of age, and commenced work in a steel wire mill in New Haven at the age of sixteen. Until 1888 he was a laborer in the mills of the Pittsburg Wire Company. He worked himself up through various stages until he became General Superintendent of the Oliver Steel and Wire Company. He was made President of the United States Steel Corporation in 1911.

Trade Inquiries

The Weekly Report of the Department of Trade and Commerce contains the following inquiries relating to Canadian trade. The names and addresses of the firms making these inquiries can be obtained by those specially interested in the respective commodities upon application to the Inquiries Branch, Department of Trade and Commerce, Ottawa:

604. **Pails and buckets, barb wire, wire nails, cement, explosives, etc.**—A Glasgow exporting house with extensive trade abroad desires to make arrangements with Canadian manufacturers for purchasing the following: Enamelled pails with covers; galvanized buckets; galvanized barb wire; wire nails; cement; explosives; spades, steel tools, and safes.

605. **Pig iron.**—A Birmingham firm is in the market for mine pig iron, hematite pig iron or charcoal pig iron.

606. **Steel.**—A firm in Birmingham is open to purchase steel, sizes: ¼ inch to 3 inches round, ¼ to 3 inches square, and 1 inch by ¼ inch flat, up to 8 inches by ⅝ inch.

607. **Iron and steel.**—An English firm is open to represent a first-class manufacturer of iron and steel.

608. **Steel billets.**—A Birmingham firm that has hitherto purchased steel billets from the continent of Europe is open to consider quotations.

609. **Steel plates.**—A Norwich firm is in the market for mild steel plates up to 6 feet long and from 12 inches to 36 inches wide, from ½ inch thick down to 26 gauge. Also flat-iron bars of all sizes and thicknesses.

610. **Wire nails.**—A Nottingham firm inquires for quotations.

611. **Spikes, bolts and nuts.**—A South African agent is prepared to take up agency for South Africa in railway dog-spikes, also cart and carriage bolts and nuts. Immediate correspondence is requested.

620. **Lumber, iron and steel.**—A Paris broker invites correspondence from exporters of spruce, pine, oak and fir; also from manufacturers of cast-iron and steel and structural steel.

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A Period of Watchful Acting

IT is a far cry from old London to Edmonton in the Canadian West, but distance sometimes intensifies the things we have in common. Points of common agreement will be found in the letters by Messrs. Gorman, Clancey & Grindley and Mr. W. A. Mountstephen, of London, England, published in this issue. The outstanding principle to which they both subscribe is the economy and general wisdom of putting constructional work in hand now, at a time when conditions are more favorable to the building owner than they have been for years.

We are too prone to surrender our ambition and enterprise to the idea that this is a period of "watchful waiting;" rather should it be a period of watchful acting. This is a strenuous day, in which the whole world is undergoing a process of remodelling. In the very nature of things, conditions can never be the same again, and we must adapt ourselves to the requirements of the hour. Many there are who are watching and waiting without contributing a turn of their energy and resources to the wheels of the Empire's business. Supposing Great Britain had committed herself to a period of watchful waiting when the Kaiser and his hordes swept over Belgium and made for Paris—the national flag of the Devil would now be floating over the Parliament Buildings at Ottawa.

Those who cannot fight should at least take an active—yes, and a strenuous—part in promoting the activities of the country. In our field we are committed to constructional activity, and each one of us can exert an influence which will tend to encourage building rather than to discourage it. At the risk of weary reiteration, let us remind the man with money to build that materials are at rock-bottom, that labor is plentiful, and that contractors are tumbling over themselves to get work. Let us bear in mind that every undertaking put in hand at a time like this provides employment for those to whom employment is vitally necessary, and that it exerts an upward influence tending to encourage others to follow the same example; while, on the other hand, every contract cancelled, every constructional undertaking postponed, contributes to the sum-total of unemployment and exercises the minds of others unfavorably. Great though the trial through which we are passing, there must come an end to this hateful conflict, and the ensuing days will be days of prosperity—marked prosperity for those who have hung on—for those who have counted optimism and confidence more worth while than pessimism and dull despair.

The call to-day in the business world, as in the military world, is for the best. Always we need strong men—men strong in brain and brawn, strong in devotion and principle, in confidence strong, and in work strong.

Out of the Wilderness

THERE was a man of a philosophical turn of mind who once made quite a reputation for himself by writing a little treatise upon efficiency, in the course of which he said something to the effect that if a man could make something which the public wanted, and make it a little better than anyone else, the world would make a beaten path to his door, even though he lived in a wilderness.

This is a pretty sort of a statement, but it does not work out in practice. If you have made something which the world wants, and made it a little better than any one else, you are still a long way from getting the world to use it. You must get upon the house-tops and shout about it so long and so loud as to make the public curious. Unless you do they will not buy. They will not make any beaten path to your door, even though it be located at the most expensive corner in your town, but they will go to the merchant in a back street for a substitute material, if he has been wise enough to understand that the general public not only want goods to fill their requirements, but at the same time want to be persuaded by argument and oft-repeated announcement that they are getting the best value for their money.

The facts of the case as regards the actual merits of the goods have much to do with securing and holding the trade, but no matter how good your wares may be they will not bring you sufficient trade to keep the bailiff away unless you let the consumer know about them and do something in the way of educating the consumer to a proper appreciation of their merits for fulfilling his particular requirements.

Engineers as Viewed by Contractors

By Richard W. Sherman[*]

COMPLETE harmony cannot exist between engineers and contractors, as each represents opposing interests. The engineering graduate starts with an educated prejudice against contractors, whom he believes to be, in the main, determined to get the best of engineers; and therefore he is on his guard, and purposes not only to take care of himself but to get the best of the contractors.

Contractors dread the "boy engineer" just from college. These young engineers are extremely technical. They expect a literal compliance with every iota of the contract obligations by the contractor.

With rare exceptions, men greatly improve in learning, wisdom, and disposition as they grow older. After twenty or thirty years, a man is surprised to find how little he knew when he started his professional or business career. He has grown riper in judgment, and has developed greater caution, discretion, and justice towards others. He grows considerate, amiable, and kind.

Contractors are largely influenced by their opinions of engineers. The engineer who has a reputation for ability, honesty, fairness, and good disposition will attract bidders for any work of which he has charge; and the desire to do work under him would be an incentive to reasonably low prices. It is a feature of contracting to size up the engineer with as much accuracy as possible.

In bidding for work, contractors are almost as sensitive as weather-vanes. It may be possible to make a profit at a given bid under one engineer, and impossible to avoid a loss under some other engineer, with all other conditions similar, and the quality and the merits of the work constructed being equally good at the same cost to the owner in each case.

A majority of bids are too high. The highest bid is often twice as much as the lowest, even when the lowest is sufficient. Over-anxiety to secure the contract is the commonest cause of low bidding. Low bids are often made to keep a contractor's organization together for future work on which he hopes for better prices.

Contractors who do not care for the contract often bid fairly high up, without any expectation of securing the contract, but merely to avoid a reputation among contractors of being low bidders, and with the bare chance of getting the work at good prices. Excessively high bids are usually the result of lack of knowledge of the value of the work and lack of time to become familiar with it.

If an engineer's preliminary estimate is believed to be too low, it drives away bidders and tends to indifferent, high bidding. Some over-anxious contractors may be influenced thereby to bid too low. They may secure the work, in which event the engineer has an unpleasant task during construction. There is almost sure to be a disposition on the part of the contractor to save himself from loss, and he is thus tempted to slight the quality of the work. Both contractor and engineer are in some degree injured by the work having been done at less than cost.

An engineer who can make reliable preliminary estimates will find his services in demand by municipalities, corporations, and other owners; or, if he chooses to practise as a contractor's engineer, he will find his services of great value in that field. Some prominent engineers of my acquaintance would not under any circumstances do engineering work for contractors, confining their services entirely to the owners. I know of other engineers who confine themselves wholly to engineering for contractors, and who do a large business as engineering experts for contractors, in litigations.

These two fields of engineering are becoming more and more distinct, and it is my opinion that an engineer is wise who makes his choice and adheres strictly either to the one line of practice or to the other.

The contracts and specifications on very large and important works are usually models of perfection. In smaller works, such as may amount to, say, not over $200,000, contractors are often confronted with bidding papers, contracts, specifications, plans, etc., which are a disgrace to the engineer who drew them.

There are a few engineers who are sometimes called "specification fiends." They write to many places where work is advertised, for specifications, etc. They read them eagerly and often clip such paragraphs as catch their fancy—usually those which are harsh, severe, and unreasonable from a contractor's standpoint. With these clippings to aid them, they draw up specifications, etc., which often deserve the name of "crazy-quilt" specifications. Such papers are full of contradictions, useless paragraphs, and ambiguities which are almost sure to cause contention and trouble during the construction and in the final settlement, or lead to litigation. Such engineers are apt to insert severe conditions such as excessive cash deposits with the bids, unreasonably short time in which to construct the work, excessive per diem liquidated damages for overtime, excessive bonds, and sometimes excessive retained percentage where monthly payments are provided. About all they can think of is to make the work undesirable and objectionable to contractors. Such engineers and their work are often avoided by the best class of bidders, and the contracts are apt to go to rather undesirable contractors.

---

[*] Chief Engineer of the New York State Highway Commission.

LETTERS

Chlorination of Water

Ottawa, May 14th, 1915.

Editor, The Contract Record:

I wish to point out that, although the short abstract on "Chlorination of Water" appearing in the May 5 issue of your paper is generally correct, there is one misstatement. I am credited with the opinion that hypochlorite treatment with calcium hypochlorite is the most practical method of purifying the Ottawa River. This is quite contrary to my present opinion, however, and to all that I have said in the past, as I believe that chlorination should be regarded merely as a temporary expedient when used alone, though it is of great utility when used as an adjunct to other forms of purification for increasing the factor of safety.

The point under discussion in Montreal was "the most economical and efficient method of chlorination," and I gave reasons for the opinion I hold that calcium hypochlorite, when properly applied and thoroughly mixed with the supply by mechanical methods, is just as efficient as, and much more economical than, liquid chlorine. As I pointed out, many of the plants using bleach are not using the material on hand to the full advantage, whereas newer installations of liquid chlorine are so designed as to reap the advantage of the past failures of others.

Hoping that you will give publicity to this correction.

Yours truly,

JOSEPH RACE,

City Bacteriologist and Chemist.

* * *

Western Contracting Firm Find "Much to be Thankful For"

Edmonton, May 17th, 1915.

Editor, The Contract Record:

In reply to your inquiry as to building prospects in this locality, we may tell you that, while general business conditions are not normal by any means, there is still much to be thankful for in the West. Last year we had good crops, which realized good prices; and the prospects for the present season are good.

In this section of the country, particularly, the building trades are not in a very promising condition—that is to say, as far as houses and speculative blocks are concerned; but just the same there are hundreds of people who will see the wisdom of building now, and benefit accordingly. The farming proportion of our community is the most envied. The farmers are in the best position to improve their houses and build new ones.

As you say in The Contract Record, this is the time to build. Of course, nothing is cheap unless needed; but one can tell the townspeople that if they have been paying rent, and have any money, they should BUILD NOW, and own their own home. One can give the "BUILD-NOW" advice to the farmer who has been living in a shack and housing his family less comfortably than his stock.

We know of nothing entering into the constructional business that is not cheaper now than it has been for years before. It is not necessary to commit oneself to buying; let him ask for prices on material and labor, and see to what a low level the dollar sign has descended.

Yours very truly,

GORMAN, CLANCEY & GRINDLEY, LIMITED.

* * *

An Old Country Viewpoint

16 Regent Street, London, England.

May 12, 1915

Editor, The Contract Record:

I have followed with much interest recent discussions in your paper—notably the one on trade development, but there is one subject which offers great and useful possibilities, particularly in such an issue as your forthcoming Annual Number. The subject may be summed up in two words which it is in the interests of the constructional field to impress upon the public—BUILD NOW. It would be impossible to devote too much attention to such a campaign, and if a number of your influential readers were to submit their views for editorial comment the discussion could not fail to carry much weight.

It is not sufficient to tell the financial interests that building materials are cheap, that labor is plentiful, and that contractors want work. These things are true, but there are even more compelling reasons. It is estimated that in the United Kingdom the contracts suspended on account of the war represent some hundred million pounds. When the war is over this work will go forward, and the demand for material will be enormous. In addition there will be the rebuilding of the ruined towns and villages of Belgium, France, Poland, and—shall we say?—Germany. The cost of living will be higher after the war, and as labor will be greatly in demand it will undoubtedly be an important factor in the situation. Not only this, but everyone will be looking for capital, and the rate of interest will be high.

The "Build-Now" policy, put into effect, will stir up business, release some of the money that is tied up, and ease the great pressure which otherwise will ensue upon the declaration of peace.

Yours very truly,

W. A. MOUNTSTEPHEN.

The Passing of a Type

HANDLING men, as opposed to driving them, is rapidly replacing the old-fashioned method of doing work. The bullying, blustering, foul-mouthed walking boss of but a few years ago is rapidly disappearing from construction work, and the quiet-spoken, tactful superintendent, quite frequently an engineer, is taking his place. The change marks the passing of a type, says The Engineering Record. The laborer of today is a different kind of man from the laborer of ten years ago; the increasing proportion of plant and mechanical equipment on construction work has brought about the change. The proportion of skilled workmen to the kind whose intelligence is equal only to the wielding of a pick and shovel and the use of a wheelbarrow has been greatly increased. The old type of workman expected browbeating and even brutality. But the new type resents it, even to the point of refusing to work. The thinking contractor realizes the change that has taken place and adapts his methods to suit. His aim is to get the maximum output from each man and, to accomplish it, he devotes his efforts toward developing a spirit of co-operation, of enthusiasm and of interest in the work.

Coleman Roads—Their History, Location and Construction

Specially contributed by H. T. Routly, D. L. S , A. M. Can. Soc. C. E.*

COLEMAN township was named in honor of Prof. A. P. Coleman, of Toronto University. It lies on the Temiskaming and Northern Ontario Railroad, three hundred and thirty miles north of Toronto. Within its boundaries are the famous Cobalt mines, which produce about seventeen million dollars' worth of silver and pay ten million dollars in dividends annually. It has been estimated by competent authorities that they have produced two tons of pure silver for every working day since they began to operate. The township has the highest assessed value of any township in the province with the exception of York. The bulk of its revenue is derived from its proportion (one-half) of the provincial tax of three per cent. of the profits of all mining companies in excess of ten thousand dollars per annum. Of Ontario municipalities the city of Toronto alone has a greater revenue from income tax. Its municipal organization is similar to that of other townships, but in the practical administration of its affairs it has attained a near approach to the commission basis. It was organized in April, 1906, with Mr. P. J. Finlan as Reeve, but on the incorporation of the town of Cobalt Mr. Finlan resigned to become its first Mayor, and Councilman Arthur Ferland was elected Reeve. Mr. Ferland has been Reeve by acclamation continuously since that time, there having been no municipal election in the township for eight years. The personnel of the Council has changed slightly, but two of the members have also served continuously since its incorporation. Mr. Ferland, who is a man of wealth and leisure, devotes a great deal of time to the township's affairs, occupying a position analagous to that of General Manager of a company—minus the salary.

Grade improvement on Haileybury road. Grade reduced from 18 per cent. to 6 per cent.

The township of Coleman is unique in other respects. In outline it is very irregular, owing to the prior location of the Temagami Forest Reserve and the Gillies Timber Berth. It has practically no agricultural lands, the mining areas being very rough and rocky, and the more level portions mostly swamp lands or sand plains. It has no fixed road allowances, but five per cent. of each lot is reserved for highway purposes, and the roads may be made wherever desired by the municipal authorities. Throughout the township road material in a natural state is exceedingly scarce, but this lack is compensated for by an almost unlimited supply of the finest trap-rock in the waste dumps of the various mines, and this trap-rock is most plentiful where mines are thickest and roads most required. In the early days, when rock containing under 40 ozs. (about twenty dollars' worth) of silver to the ton was considered "waste," some of the roads were built of this material which may eventually be recovered and run through the concentrating mills for the value it contains. Now all dumps containing 10 ozs. or over are reserved, and waste rock is not so plentiful, but in the meantime the roads have been built, so that it makes little difference.

To the highway engineer Coleman township is

Stone Culvert on Haileybury Road.

Lang St., Cobalt, from the Square. Macadamized by Coleman Tp. in 1911.

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* Of Routly & Summers, engineers and contractors, Huntingdon, Que.

The Square, Cobalt. Laid with Rocmac in 1911.

Typical section on Latchford road, built with boulders on boulder bottom

most interesting, as it offers unlimited difficulties in both location and construction. The writer, as Engineer and Superintendent of Construction from May, 1909, to July, 1913, had charge of all road work, and during this time practically all the roads were located and opened up, and the principal ones macadamized. During this period approximately one hundred and sixty thousand dollars was expended by the township on its own roads and on roads in the adjoining municipalities of Cobalt, Latchford, Bucke. Firstbrook, and Lorrain. The choice of location for the various roads was the most important and most difficult feature of the work. The general location was determined by the position of the various mines to be served, and these mines are located without regard to latitude, longitude, or altitude. Several of the main roads had been located and received considerable treatment in 1907 and 1908, and the foreman in charge followed the ridges, with their innumerable ups and downs, and avoided flat places or ravine bottoms. This was a costly error, and in many cases the roads had later to be rebuilt in order to secure uniform grades at permissible cost. No theoretical limits could be established for grade or curvature, but, having established the general location, each portion was so treated as to make the best of the possibilities, having due regard to cost and traffic requirements.

Immediately after assuming charge of the work the township was urged to purchase a road-building plant. For various reasons this was postponed until the second season, but the good results were so immediately apparent that the plant has been operated continuously each season since, and all the main roads in the township have now been macadamized. The principal streets in the town of Cobalt and a trunk road from Cobalt to Haileybury have also been constructed. Plans, profiles, and estimates were also prepared in 1912 for extending this road five miles further to the town of New Liskeard. The plant consists of a ten-ton Buffalo Pitts roller (a most excellent piece of machinery), a Champion portable rock crusher with bin and screens, sprinkler, dump wagons, etc. Note the entire absence of grader and scraper; these implements, so necessary in the ordinary road construction, were out of place in Coleman. The plant was always kept in thorough repair, and the best men available secured for its operation. During 1912 the roller was operated twelve hours a day, and part of the time seventeen hours. This was an exceedingly wet season; yet this roller operated one hundred and seventy-

Switchback road located and built on their property by the McKinley-Darragh Mining Company.

The Coleman roller. Cobalt Lake, shown in the picture, is now being dewatered to permit the mining of bottom.

Rock cut on Haileybury road.

five ten-hour days. Much of the work was on the heaviest grades, but the amount of coal used was only 347 lbs. for a ten-hour day. The original grates were in first-class condition at the end of the third season, as were also the cylinders and other working parts. The crusher was also subjected to very hard usage, as chunks of solid ore, steel bits of machine drills, sledge hammers, and such things, were quite common in all dumps, and often found their way to the crusher. As much as three wheelbarrow loads of such material has been picked out at a single set-up. In spite of this and the tough nature of the rock, the total cost of maintenance and repairs (including jaw and check plates) was only thirty per cent. of the original cost, including thorough overhauling at the end of the third season. It was driven by a 20 h.p. electric motor at a cost of from fifty to sixty dollars a month. This was made up by a flat charge of twenty dollars a month, three cents a kilowatt-hour for power used, and the cost of erecting and dismounting transformers and connecting wires. Prior to macadamizing, all revisions of alignment and other improvements to the subgrade were made, where possible, during the previous season. Of the original main roads of 1907 and 1908 several sections were re-located, and in many cases the ridges were abandoned and the roads laid in the ravines. In some cases the new road was placed just at the edge of the ravines, the outside being hand laid retaining wall high enough to form a shelf of sufficient width for a road with the least amount of material. Guard rails were at first vetoed by the Council, but were finally adopted. The posts were built into the wall during construction, and afterwards finished with two 2 x 6 railings. Many sections of road are along the sides of steep, rocky hills, and these dry rock walls are ten feet or twelve feet high. They are built for strength; the largest stones are used, and are not faced, but bedded. In a few instances the side hills on which they are constructed are so steep that a place for footings had to be blasted out, and in one instance a rock bolted concrete footing was necessary. On steep slopes retaining walls were necessary for economy of material, and strength was necessary to permit of rolling. The inferior walls built at first frequently had to be rebuilt before rolling was possible. The lines were given by erecting and bracing 1 x 5 templates every fifty feet on straight walls, and closer on curved walls. They were usually battered about three inches a foot, but this varied according to local conditions. The best walls were built at a cost of $1.50 to $1.65 a square yard for laying. This included hand-laying the backing to a total thickness of from two to five feet. Owing to the saving in the material, the fine and finished appearance was generally obtained at no extra expense over the cost of rough rock fill. Many of the ravines and other low sections which were avoided by the earlier locators proved excellent roadbeds, usually being underlaid by coarse open boulder formation, and readily drained. Some of them, however, were so deep and soft at first that horses could not be used, but when opened up they have supported stone roads under the heaviest traffic without settlement, although the vibration or tremor under traffic can be felt to a considerable distance.

A fine piece of road near the Colonial mine, built in 1909.

The difficulties did not cease with the location and construction of the subgrade. During macadamizing it was seldom possible to divert traffic, some of which was heavy hauling of ore, coal supplies and machinery, in addition to the more troublesome light fast driving. Trap rock does not re-cement or bind of itself, and no amount of rolling will consolidate it. Good lime rock of the two-inch size, can be rolled dry until it ceases to "weave," because it crushes and binds together. Granite will also become "sett" because of its gritty fracture. Trap rock will not crush together under the roller, and is of such fine grain and smooth fracture that even small sizes can be rolled on a solid foundation and will remain perfectly loose indefinitely and continue to weave or move during rolling. The ordinary macadam specifications are not applicable to this material. There is no lime stone in Coleman, and the cost of lime stone grit brought from the Southern Ontario quarries was prohibitive. In some parts of the township a cementing clay gravel was obtainable where mining companies had carried on deep surface trenching, and this was used with good results. The general method adopted, however, was to cover the top course of two-inch stone with an inch or so of screenings, and by continuous rolling and sprinkling wash this into the macadam, filling the interstices from the bottom upwards, always keeping a considerable quantity of screenings on the surface to protect the top layer of stone from being ground by the excessive rolling. The upward progress of the filling action was indicated by the water. For some time this would run through the road instantly, no matter how fast it was applied, but as the lower portion became filled and consolidated less water was required, and by digging into the road with the heel the water level and stage of construction could be determined readily. The top stones remained perfectly loose until the filling action caught them from below. Presently the water, instead of rushing down through the road, began to flood off to the sides, the surface became filled and "set," and the road was bound. No wave of mud or slurry was ever obtainable. Trap rock will not produce mud unless ground exceedingly fine, and hence these roads are perfectly clean and free from mud in wet weather. The wearing surface consists of 1 in. to 2 ins. of screenings, which on this impervious foundation can be bound hard and smooth, resembling sheet asphalt, but not slippery. In wet weather this surface is clean, producing no mud, but on hot dry days it disintegrates and rapidly blows away, producing considerable dust. The cost of macadamizing after the preparation of the subgrade ran between eighteen hundred and two thousand dollars a mile. As so much of the township has been entirely denuded of trees, and as the roads are usually elevated above adjoining lands, the sun and wind have maximum effect. In addition to this, motor buses and cars were found destructive, and to meet these conditions many experiments were tried with various kinds of road oils. Nothing gave satisfactory results until Tarvia "B" was tried. The first tank car was purchased and applied in June, 1913. The writer severed his connection with the township shortly after, but recommended the continuation of Tarvia treatment, and during the seasons of 1913 and 1914 the sum of $7,116.32 was expended in applying 33,349 gallons to 14.35 miles of road, or at the rate of about $500 for 2,400 gals. a mile. The quantity is about right, but the cost should not have exceeded $400 a mile.

Road around Kerr Lake.

Another patent road binder used was Rocmac. In June, 1911, 990 square yards of this was laid on Cobalt Square—"the busiest spot in New Ontario"—at a cost of 93 cents a square yard. Although subjected to severe flooding during several big fires, it has proved very satisfactory, being at its best where the traffic is the heaviest.

Wages varied from $2 for laborers, $2.50 for foremen, and $5 for teams, in 1909 to $2.25 for laborers, $4 for foremen, and $6 for teams, in 1913. Dynamite was in almost daily use by nearly all the gangs, but no serious accident occurred to either persons or property. Several hundred cubic yards of rock were taken out in the Cobalt streets, and in the township we were always close to electric transmission lines, telephone lines, compressed air pipe lines, or other unprotected structures. This immunity from accidents was due to the employment of skilled workmen, to careful supervision, and to the fact that the foremen and men were constantly reminded that the township was willing if necessary to pay a little more a cubic yard, but that they wanted no accidents, and that carelessness meant dismissal. It is most difficult, however, to get capable, experienced rock men to take reasonable precautions for the safety of themselves and their fellow workmen, and a large proportion of the accidents that occur with explosives are due solely to the deplorable recklessness of the workmen themselves.

The results obtained locally by the use of Coleman trap rocks as road material have attracted much attention, and many have investigated the feasibility of supplying this material to Southern Ontario municipalities. In 1912 a trial shipment of twenty carloads was made to Toronto, part being used on the Kennedy Road, near Scarboro, and the balance on Dundas Street in the city. At the latter place a short but strenuous "stampede" was engineered by an ex-Cobalt prospector, who "salted" the rock piles on the street with rich silver speciments from his cabinet and allowed himself to be discovered finding them. Much of the rock contained showings of pyrites, white iron, or smaltite, and some "rich stakes" were carried off by the lucky first locators.

Concrete Blocks on the Original Panama Canal Contract

CONCRETE blocks made by the French Canal Company in 1886 have been used extensively in beach protection, and their use appears to be well warranted by the endurance of the material. Although the concrete was formed in blocks like cut stone, and not made monolithic as in all recent works, its endurance under severe weather conditions is remarkable. The materials used were Portland cement, Bohio rock, and Panama beach sand. In quoting the specification under which this concrete was made, Col. Goethals says:—

> "The Bohio rock is volcanic agglomerate of rather low specific gravity and medium hardness, but very resistant to atmospheric weathering. During severe "northers," the breakers have sometimes been strong enough to roll the blocks upon the beach."

The French records of the contract of 1886, under which these blocks were made, contain the following specifications:

> "Stone to pass through a ring 0.06 m. (2.36 in.) diameter, and to be washed and screened to eliminate all particles smaller than 0.02 m. (.78 in.) diameter. The cement mortar to be composed of 800 kilogrammes of cement mortar to 1 cu. meter of sand. These materials to be mixed dry upon a wooden platform under a roof, and water to be added by means of sprinkling hose, taking care to use only as much water as may be necessary to produce a homogeneous mortar which will stick to the shovel. The concrete to be composed of 2 parts of mortar and 3 of stone. After the mortar shall have been mixed as specified above, add the stone, and mix with an iron hoe, until all of the stone shall be completely covered with mortar; the mixing to be accomplished without further addition of water; the stone, however, to be watered carefully in the pile, at least one hour before using."

Dust Prevention: Method of Application and Use of the Various Oils

THE method of application and the amount of oil that should be applied will depend upon the kind of oil used, the condition of the surface of the road on which it is to be used, and other local conditions. The light oils should be applied more frequently and in smaller quantities than the heavy oils. The crude or the refined oil may be applied either cold or hot, according to its quality. Most crude oils, and some refined oils, have been applied cold; but it is necessary to heat the heavier oils before they are applied.

The oil is shipped either in barrels containing from about 30 to 50 gals. each, or in steel tank cars containing from 6,000 to 10,000 gals. each. If a heavy oil is used, it is necessary that the tank car be equipped with steam coils in order to heat the oil, that it may be drawn or pumped from the tank.

When the material is shipped in barrels it is customary to heat it on the roadside in heating kettles holding from 4 to 10 bbls., from which it is applied to the road surface by the use of hand pouring pots of about 4 gals. capacity. It is important that these pots be provided with spouts that will spread the oil in such a way as to produce an even distribution, as in this lies the secret of the success of its application. The ordinary water sprinkling spout with the holes punched larger with an 8 d. or 20 d. wire nail, depending upon the grade of material being used, will usually give very satisfactory results.

When the oil is shipped in tank cars, it is usually applied to the road from tank wagons, holding from 400 to 800 gals. Tank wagons used for this purpose may be classified under two heads: (1) Gravity tanks, which allow the oil to flow by gravity through a perforated pipe, which sprinkles the oil onto the road. (2) Pressure tanks, which spray the oil under pressure onto the road through perforated pipes, or a series of nozzles, or a single large hose and nozzle. The pressure is produced either by steam or compressed air in the tank itself, or by pressure in the distributing pipes only, induced by some form of pump.

When the oil is applied to the road surface in the form of a fine spray, which can be done with the pressure tank wagon, a more even distribution and better penetration is secured. The pressure tank wagon is particularly valuable when it is desired to use a very light application of oil. By the use of such a wagon, so light an application as ⅛ gal. per square yard can be evenly spread, while about 1-3 gal. per square yard is as small a quantity as can be uniformly distributed with a gravity tank. The use of the pressure tank has an additional advantage; when the oil under pressure comes into contact with the stone with some force, it blows the dust from the surface, and thus by cleaning the stone secures a better adhesion of the oil. This is very beneficial with the heavier asphaltic oils where it is absolutely essential that the surface of the large stones be exposed and clean in order to insure a good bond. However, if the oils are not too heavy, and the road is gone over several times with the gravity tank and a very light application given each time, a very even distribution can be secured and fairly good results obtained. The tank wagon is sometimes provided with a heating arrangement either in the form of a fire box underneath, or in the form of steam coils to be attached to the roller boiler. With such an equipped tank, the heavier grades of materials may be applied.

In general, it is better to give the middle of the road a heavier application than the sides. This is especially true in the case of the lighter oils and emulsions, and calcium chloride solution, owing to the tendency of these materials to being carried to the sides of the road by gravitation and running water. While in the case of the lighter oils, no cover is necessary after the oil is applied, yet better results are usually secured by covering the oil with a layer of coarse sand. When the heavier oils that require heating are used, it is essential that they be covered with either screenings or coarse sand. Stone, slag or gravel screenings are best suited for this purpose. The screenings should be dry and clean and free from dust, and of a fairly hard material. A size that will pass a ½-in. circular mesh and be retained on a ¼-in. mesh is usually very satisfactory. A size that will pass a ¾-in. screen and even a 1-in. screen is sometimes used with perfect satisfaction. The heavier the grade of oil that is being used, th coarser the screenings may be. If the surface is afterwards rolled, larger screenings can be used than where traffic alone compacts them. Unless a heavy oil that stiffens quickly upon exposure to the air is being used, it is best to allow the oil from 5 to 36 hours' time to be absorbed by the road surface before applying the screenings. It often happens, however, that the road cannot be closed to traffic so long, in which case the screenings are put on immediately after the oil is applied, with very good results. If the oil stands in little pools on the surface after it is applied, it should be gone over with hand brooms and the puddles of oil broomed evenly over the surface before the screenings are spread. This will aid in producing a more uniform surface, and uniformity of surface is not only one of the essentials in buiding a road, but it is also one of the essentials in maintaining a road.

Dust prevention is so closely associated with road preservation that the two should usually be considered together, for any method of preserving the surface will invariably reduce the dust. It might be well to state, however, that such surface treatments of oil do not constitute the building of a road. At its best, it constitutes merely a maintenance proposition. It is a false notion to hold that an old worn-out, rough road surface can be made good by the application of a little oil. In order to maintain a good surface, it is essential that the surface be put in a good condition previous to the application of the oil. Therefore, unless it is merely intended to temporarily allay the dust, the holes and ruts should be eliminated from the surface before any oil is applied. The depressions in the road should be cleaned of all dirt and foreign material, the edges cut vertical and the bottoms loosened by picking. The depressions should then be filled with stone, slag or gravel of the same quality and size as the remainder of the road surface, and this material thoroughly compacted by hand ramming or rolling.

Poor results in the use of oil treatments frequently come from the fact that the surface had not been previously cleaned in a proper manner. The practice of some small villages of putting oil on a road surface already covered with several inches of dust and filth, cannot be too severely condemned. When such practice is followed, the street, after every rain, will be covered with a black, oily mud, which may be as objectionable as the dust itself. Before the lighter oils, such as are put on cold, are applied, the surface shuold be comparatively free of all loose dust and foreign material. Before the heavier materials, such as require heating, are applied, it is very important that the surface be cleaned of all matted dirt, dust and foreign material, so as to expose the large stones in the surface of the road. If possible, the surface should be swept with horse sweepers, and afterwards with hand brooms so as to remove the dust from between the stones to a depth of from ¼-in. to ¾-in. The heavier the grade of oil used, the more important it is to have a clean surface on which to apply it. The surface should be dry and the warmer the air temperature the better.

There has been considerable discussion during the past year concerning sprinkling of the stone with water before applying the bitumen, this information is likely to be misleading; for it is believed that it is not the presence of water that might cause the better results, but the effect the water has in cleaning the dust from the stone which gives a better adhesion of the oil. Hence, we would conclude that if sprinkling with water before applying the oil is done, it should be on only hot, dry days,, and then sufficient time given after the sprinkling for the water practically all to evaporate before the oil is applied. Therefore we are still warranted in saying that bitumens should be applied only to dry, warm surfaces. During June, July and August is the best time of the year to apply such materials to the road surface.

The amount of oil that should be applied to the road at any one time will depend upon the condition of the road surface, the quality of the oil used, and the nature of the traffic. In general, it may be said that a couple of light applications during the year will give better results that a single heavy application for the same amount of oil. For the lighter oils, on a comparatively smooth surface, an application of not to exceed ⅛ gal. per square yard may be all that should be applied at one time, while on a rough, pitted surface with the binder swept from the top surface of the road to a depth of from ¼-in. to ¾-in., as much as ¾ gal. per square yard of the heavier oils might give more satisfactory results. Precaution should be taken, however, that there is not an excess of oil applied, as too heavy a coat of the lighter oils is objectionable because of the formation of a black, frothy mud after a rain, while an excess of the heavier oils will form a thick mat on the surface which will be peeled and picked up by the horse-drawn traffic. The heavier the automobile traffic, the greater the amount of oil that can be applied up to a certain limit. The aim should be to put on just sufficient oil (and screenings) to form a thin mat over the surface of the road. This mat should not be of any appreciable depth over the surface of the larger stones, but sufficient to well seal up the voids between them. This will hold the binder in the stones and make the road surface water tight.

The cost of oils varies according to the quality of the oil. Also the price of the same oil fluctuates from time to time. The cost of applying the cold oil varies from ½c. to 1c. per gallon, while the cost of applying the hot oil will vary from 1½c. to 3c. per gallon.

The preceding information is abstracted by Engineering and Contracting from a bulletin on Dust Prevention, issued by the Highway Department, State of Ohio.

Corrosion of Iron and Steel Water Mains

IN a paper on this subject read by Mr. W. J. E. Binnie at a meeting of the Institution of Sanitary Engineers (London), the author said that internal corrosion and incrustation of the pipes caused a material reduction in their carrying capacity. This had to be allowed for by designing the pipes of such diameter that they would still be able to pass the required quantity of water, even after incrustation had taken place. Although incrustation could be removed by mechanical means, the protective coating could not be restored, and once scraped, the pipe deteriorated rapidly, required frequent rescraping, and presented fresh surface for attack, with ultimate reduction in the strength of the pipe. The economic bearing of corrosion was even more important in the case of steel than of iron, as, owing to the smaller thickness of the pipe, the loss by corrosion represented a much larger percentage loss of strength.

It has long been known that for the corrosion of iron, water and oxygen are required, and, according to the older chemical theory, the presence of an acid is also necessary. This is usually found in the carbon dioxide present in the air and water. According to this theory, this carbon dioxide combines with the iron to form soluble ferrous carbonate or ferrous hydrogen carbonate. The oxygen of the dissolved air then converts the soluble iron salt into ferric hydroxide, which is deposited as rust and liberates carbon dioxide, which is free again to attack the iron; and so the process is repeated until protection may be found by the deposition of rust on the iron. It appeared from later experiments that acid was not necessary if dissolved oxygen were present in the water, and an electrolytic theory was put forward. According to this, the water contains free positively charged hydrogen ions. The hydrogen ions tend to combine with the dissolved oxygen, but cannot do so until they obtain a negative charge. This they obtain from the iron which is changed into the ionic state, combining with the hydroxyl ions to form ferric hydroxide or rust. According to some experimental evidence, however, corrosion does not take place when all traces of CO_2 are removed, even if dissolved oxygen be present. The matter is a controversial one, but the author declared that the balance of opinion was in favor of the electrolytic theory. A biological theory has also been put forward, attributing corrosion to the action of organisms; but, as corrosion takes place under conditions that inhibit life, this explanation is improbable; although it is possible that the acid secretions of organisms in the water may accelerate corrosion in some cases.

Internal corrosion of water mains is accompanied by the deposition of incrustations of a limpet-like form, the upstream face of the limpet being steeper than the downstream face. They rarely form to a greater height than 1½ in. in large mains. They are hard without and soft within, and are composed of concentric layers of ferric oxide, the outer layers being sometimes black magnetic oxide. The iron below the limpets is invariably pitted by corrosion. Whether the electrolytic or the acid theory be correct, the presence of dissolved oxygen in the water is essential before corrosion takes place. The question naturally presents itself whether comparative immunity from attacks could be brought about by the partial removal of the dissolved oxygen from the water. In the case of a 350-mile 30-in. main between Mundaring and Kalgoorlie, Western Australia, such a course was suggested on the occurrence of severe corrosion, but was not put into practice. The idea was to remove the air by spraying in a vacuum.

As might be expected, the corrosion increases with the rapidity of flow of the water; but there appears to be a critical velocity above which the corrosion ceases to rise, and even diminishes again. Sewage contamination appears to use up the free oxygen, and, provided there is no deterious acid present, such water does not corrode the pipes to any great extent. Grease also acts as a protective. Hard waters, such as London water, are only slightly corrosive. The addition of alkaline solutions greatly diminishes corrosion. External corrosion of pipes is much increased by the presence of sea-water, and contact with ashes and cinders has a deleterious effect, probably due to galvanic action. It is generally agreed that cast iron resists corrosion better than steel, and that this is largely due to the siliceous foundry skin affording a certain measure of protection.

Experiments show that, speaking generally, the harder the steel the less liable it is to corrode. Hard steel, however, cannot be used for welded pipes. Small percentages of chromium and copper are of value in reducing corrosion; but it is important to specify a low manganese content, as manganese generally indicates the presence of manganese sulphide, which increases the liability to corrosion. Nickel is a valuable adjunct in reducing corrosion, but is only really effective in large quantities, which renders the steel unsuitable for pipes. Provided that phosphorus is limited to 1 per cent., its presence is rather beneficial than otherwise. Silicon has a marked preventive action; if there be 20 per cent. present, the product is practically incorrodible, whilst 3 per cent. has a marked beneficial effect. Unfortunately, such high percentages render the metal unsuitable for pipes, owing to its excessive hardness and brittleness. The presence of sulphur is always objectionable, as it not only tends to set up galvanic action, but forms sulphuric acid in addition. Steel which has been subjected to stress is more liable to corrode than unstressed metal. It is, therefore, important to remove the internal stress by annealing.

In the early days of electric traction considerable damage was brought about by stray currents; but recent Board of Trade regulations afford quite sufficient protection to water-mains, provided they be kept at least 2 ft. clear of the rails, and that the ground be not impregnated with salt water, in which case it is well to surround the pipes with lime concrete as an additional protection beyond the usual coating mixtures. Abroad, it is well to give the rails a wide berth, unless the regulations afford protection equivalent to that given by the Board of Trade.

For ordinary cases, it has been found that a coating of Dr. Angus Smith's solution is a fairly efficient protection against corrosion. The mixture used nowadays consists essentially of coal-tar and pitch-oil in the proportion of 2 to 1 by bulk, and the pipes are dipped in this at nearly boiling temperature after all rust and scale have been removed. There is a possibility that pinhole penetrations caused by air bubbles will impair the coating, and a second dipping is advisable. In the case of an important pipe line at Birkenhead an entire recoating of the inside of the pipes with Siderosthen, an oil-tar mixture, is specified. For outside protection a wrapping of hessian saturated with bitumen is usual. The wrapping on the joints and on places where the hessian has been damaged in transit has to be done in the field.

Although Chlorinated, B. Coli Increase in Number

MULTIPLICATION of B. Coli in bleach treated waters in summer has been noted by H. E. Jordan, chemist for the Indianapolis Water Company, in a recent paper presented to the Indiana Sanitary and Water Supply Association. Mr. Jordan was controverting a statement which appears in the report of the experts promulgating a standard of purity for interstate carriers. Of 201 samples, 21 gave positive B. Coli reactions immediately after treatment, 39 after 24 hours standing and 42 after 48 hours. The increases were confined to the warm months. From November to April actual decreases were noted. These studies are now being carried out in greater detail to obtain all possible information as to the ability of a bleach-treated filtered surface supply to meet the standards after various lengths of exposure to various temperatures.

There still remains a tendency among filter men to avoid giving out definite information on their B. Coli findings, which indicates, said Mr. Jordan, a mistaken idea that these bacteria are necessarily a bad indication or at least that a statement of such findings will be the basis for criticism. He gave, however, results from four plants. For nine years, Washington, D.C., operating with a raw water carrying B. Coli 18 per cent. of the time, has reduced the presence of the organism in 1-cu. cm. samples to 0.8 per cent. of the time. At Indianapolis, for eight years B. Coli were present in the raw water 48 per cent. of the time and in the effluent 3.1 per cent. Lawrence raw water carries the germ in large numbers at practically all times. Its filtered water samples for 17 years have contained B. Coli 10.8 per cent. of the time, ranging as high as 18 per cent. for three years. At Harrisburg the raw water is rarely free but the average percentage of time during eight years when B. Coli were present in the effluent was 1.1. In these cities water has been eliminated as a factor in typhoid fever causation. Data from Pittsburgh and Albany are too meagre for tabulation but show that these plants do not continuously attain the carriers' standard. However, both plants have effected marked and continued reduction in typhoid death rates.

Mr. Jordan concluded that while the standards are not intended for public water supplies, their operation necessitates their conforming to it; that the assumption of non-multiplication of B. Coli is not beyond dispute, and that public water supplies are being safely used which do not continuously meet the standards.

Erratum.—In the publication of the article, "The Design and Construction of Buildings for Industrial Purposes," which appeared in our last issue, the credit was inadvertently omitted. The article was an extensive abstract of a paper read before the Royal Institute of British Architects (London, Eng.) by Mr. Segar Owen.

Features of Park Improvement Work[*]

The More Important Problems Involved in Construction and Design—
Organization of Department—Drainage—Grading—Paths—Requirements for Site

THE working organization of a park department generally comprises a counsel; landscape architect, who recommends as to location and prepares grading and planting plans and outline of general features; purchasing department, to secure real estate; an architect who designs buildings, gateways and other structures; a superintendent's department, which succeeds the engineering department and attends to gardening and planting operations and ultimate maintenance of the parks; clerical force; a secretary and treasurer of the commission; a title guarantee department or company to pass on property transactions; engineering department, consisting of chief engineer, assistant engineers, instrument men, chainmen, rodmen, inspectors, and a chief gardener and his assistants. During construction work the park is in charge of the engineering department, including any police assigned to it, after which control passes to the superintendent's department.

The work of the engineering department comprises: (a) Property surveys of lands to be acquired, with the deeds, and preparation of property descriptions to be incorporated in deeds of conveyance. (b) Topographical surveys for use of landscape architect. (c) Designs of sewerage, drainage, water supply and lighting systems and of all engineering features of walls and bridges. (d) Preparation, letting and supervision of all contracts for construction work. (e) Planting and gardening operations. (f) Maintenance of completed work until it is turned over to the superintendent's department, which may not be organized until the work is well under way or even completed. (g) Policing of all acquired areas.

General Requirements for Park Lands.—This is specifically a question of landscape architecture and common sense. The leading requirements are: (1) Parks must be accessible. City parks should be so placed that all of the population can easily reach at least one park on foot. The largest country parks should be easily reached by carriage, automobile and trolley car with reasonable fares.

(2) The park system should be a connected system, the various parks being joined by parkways or boulevards. This is a verry essential matter.

(3) A park should be located with regard to the other requirements of the territory in which it is placed. Central Park, New York City, although an asset of inestimable value, is so placed that it cuts off two of the main arteries of travel running north and south on Manhattan Island.

(4) Parks should be planned with a distinct view of the population to be benefited, the problem being worked out for each individual case. The interest of all should be considered alike—drives for the rich and resting places and playgrounds for the poor.

(5) It is a fact well known to experts that poor lands from the viewpoint of the real estate operator are often the best for park development. Low and swampy lands which are usually festering spots in cities are among this class. As an illustration, Tacony, Pennypack and Cobbs creek valleys, in Philadelphia, are narrow and deep, and if laid out in city blocks the grades of the cross streets would be very steep. Moreover, an enormous amount of filling would be required for the street construction. These valleys were bought by the city for park purposes at a price less than the cost of such street filling.

Draining.—Underdraining swampy or wet soils can be accomplished by laying agricultural tile or by stone or brush ditches. In the former, horse shoe tile laid on one-inch boards or two-foot collars of cylindrical porous clay pipe with four-inch collars or rings for the joints may be used. Two-inch, three-inch and four-inch pipe are the sizes ordinarily used. They are laid in parallel ditches joining the main at an angle of 45 degrees by Y connections. The distance apart of the trenches, their depth and the size of the tile can be determined by experience; the nature of the soil, slope of land and elevation of water table are determining conditions. If the drains discharge into an open channel, the tile should be protected from injury in some way. A 12-foot length of cast iron pipe is recommended, a "second" being suitable for this purpose.

In making stone or brush ditches, stones or poles are placed in the bottom of the trench, leaving open spaces for the passage of water. To prevent clogging with earth they are covered with branches or straw, on which the backfilling is deposited.

Park sewers are used for removing surface water and also for removing the sewage from any buildings upon the ground. The latter are generally connected with the city sewerage system or a small disposal plant. The storm sewers discharge into the nearest available outlet.

The sewers are generally laid under the sod rather than roads or walks, and in shallow trenches; and it will usually be better to occasionally dig up the sewer to remove an obstruction than to provide manholes at every change of line and grade, as in the case of city sewers.

The surface water inlet is generally merely an iron grating set in concrete over a 6-inch elbow, from which the water is carried to a catch basin or directly into the sewer. Similar gratings are placed on top of the catch basins. A catch basin may be placed on one side of a road or path and a plain inlet on the other side connected with it. The inlet grating is generally rectangular for paved gutters and circular for grass gutters or low spots in lawns.

Surface water inlets should be placed at frequent intervals, the spacing often used being 125 feet.

Grading.—Modern practice places gutters for collecting and removing surface water in the sod at one side of the drive or path rather than at the edge of the paved path thereof. These swales are usually depressions 4 to 6 inches deep and 6 to 12 feet wide running parallel with the drives and paths, their cross section showing a continuation of the line of the adjacent slopes. They are sodded and possess the advantages of intercepting storm water and preventing deposits in the sewers. Where a steep slope comes down close to the drive or path, these swales cannot, of course, be used, and cobble or stone gutters may be necessary.

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[*] From lectures prepared by William T. Lyle, Professor of Municipal Engineering at Lafayette College.

No fields or lawns should be made absolutely level, but slight slopes or depressions should be provided to remove the surface water.

Lakes and ponds should be at least 8 feet deep if possible, to prevent objectionable growths of water plants; but it is safe and proper to provide a shelf along the shore line extending out 8 to 10 feet with a drop of about 18 inches.

In constructing artificial lakes, it sometimes happens that a part of the shore lies in an unstable soil which cannot be excavated without flowing. To construct a firm and stable shore the following method has been used: A single line of piles is driven close along the shore line but with every fifth one omitted. At these gaps batter piles are driven at as great an angle with the vertical as possible, which angle can seldom be made greater than about 20 degrees if a drop hammer pile driver is used. The piles are all sawed off about 1½ to 2 feet below the proposed water surface, and a wale is framed into them in such a way that the thrust of the batter pile is transmitted to the wale and thus against the vertical piles. Bolts with washers are used to draw each pile close to the wale, which consists of 8 by 10-inch timber. The piles are notched to receive it so that the bolts shall not be obliged to take up much of the thrust. The material on the water side of the piles can be removed to the depth of the lake. Good upland soil is then dumped in over the piles to reinforce them and provide a firm shore. This soil will, of course, sink down into the soft material below and more will have to be added from time to time, until all settlement ceases. It is wise to fill in considerably above the proposed grade, and then, after say a month, remove the surplus material.

Paths.—All paths should be on an incline to provide drainage, and provision made at the low points for removing water by carrying a tile to the nearest catch basin or sewer or to a gutter or swale. Cinder or broken stone foundation is laid under the surface material of the path. These precautions are, of course, unnecessary in dry soils, and the cinder foundation is unnecessary in gravelly ones.

If paths are desired curved in their lines, these curves should not be laid out arbitrarily but should have some reason, such as the avoiding of trees, rocks or hillocks, etc. If natural obstacles do not exist, they can sometimes be introduced in the design.

In order to increase the effective width of a park walk, wings of gravel 4 feet wide on each side are often used. These wings should have the full cinder foundation.

Paths should be crowned in the middle. A crown of three-quarters of an inch in a walk 8 feet wide is ample for cement, while for gravel walks it should be (say) 50 per cent. greater. For gravel walks, hard rounded gravel with cementitious properties is desirable.

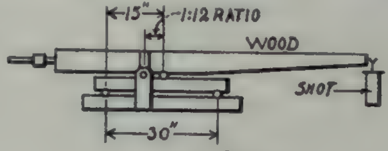
Construction.—In beginning the construction of a park, the underdrainage should be laid first. Following this, the first thing to be done is to remove all the top soil and pile it in large mounds to be used for dressing the land after the grading is completed.

Grade stakes are set, marked on the side with the proper cut or fill, measured from the top of the stake; or driven with their tops at grade, if possible, in which case the top of the stake is marked with crayon. For heavy fills long poles may be used with their tops at finished grade. Where the cuts are considerable a second set of grade stakes must generally be set after the first are dug up. To preserve the latter on mounds of undisturbed ground is expensive, and they are apt to be disturbed.

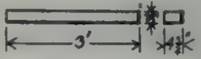
Simple Concrete Tester

FIELD tests to determine the strength of concrete can be made by means of a simple apparatus like that illustrated in the drawing herewith, which was developed in connection with work on the new Welland Ship Canal, says Cement World. The machine, while not absolutely precise, is sufficiently accurate in its determinations to serve all ordinary practical purposes.

The test pieces are made from concrete taken directly from the mixer, and are molded, as shown in the drawing, to a size 3½ by 4¾ in. in cross-section and 3 ft. long, without reinforcement. After being stored for definite periods under known conditions, they are tested to breaking under bending stress, by means of the leverage device indicated. The ratio of weight arm to power arm is 1:12. Shot of uniform size is poured into the bucket at the end of the lever; and a gauge which measures directly only the depth of the shot, is scaled to indicate in pounds per square inch the bending stress exerted on the test piece. With the exception of the steel pins and fulcrum, the apparatus is made entirely of wood.



CONCRETE TESTER



SHAPE OF TEST PIECE

Causes of Concrete Road Failures

OPERATIVE causes actually found to account for the poor results sometimes observed in concrete road construction are listed as below in a pamphlet, "Concrete Pavements in Western Washington," recently published by Reitze, Storey & Duffy, Inc., of Seattle, Wash. They are all traceable to mistakes in judgment, to ignorance, and to lack of study of the correct methods to be followed.

1. No rolling of subgrades, even on fills up to 20 ft. in depth.
2. No wetting of subgrade immediately preceding placing of concrete on the hottest of days.
3. The use of unseparated and unwashed aggregates, more commonly called "pit-run" material, used in proportion of the sum of two aggregates when separated.
4. The most careless handling and protection of the aggregates until such time as they are mixed with the cement; "I have seen aggregates piled alongside the road, so dust-covered and so thoroughly mixed with dirt from teams driving over them that at first glance one would think these piles of aggregate were simply dirt excavated from the subgrade."
5. Dirty and unclean water used.
6. The concrete poorly and carelessly mixed, handled, and placed.
7. The concrete burned and dried too quickly by reason of no covering and lack of wetting down and keeping wet after placing.

Testing and Handling Concrete Aggregates[*]

By H. S. Mattimore[†]

FOR highway paving, the selection of good materials and a first-class quality of engineering have given New York State an excellent quality of concrete. While the cement used, of course, must be of good quality, the same is equally true of the other ingredients.

Sand and Screenings

To insure a high grade of fine aggregate, the following specifications have been drawn up by the State Highway Commission:

"Fine aggregate shall consist of sand, free from organic matter; that which shows a coating on the grains shall not be used until satisfactorily washed."

"No. 1 sand for use in concrete pavements shall be of the following gradation: 100 per cent. shall pass a ¼-inch screen; not more than 20 per cent. shall pass a No. 50 sieve; and not more than 6 per cent. shall pass a No. 100 sieve."

"Sand may be rejected for this class if it contains more than 5 per cent. of loam and silt."

"Mortar in the proportion of 1 part cement to 3 parts of the sand to be tested, shall develop a compressive strength at least equal to the strength of a similar mortar of the same age composed of the same cement and standard Ottawa sand."

"Screenings when approved in writing by the Chief Engineer, may be substituted for a portion of No. 1, 2, and 3 sand under the following conditions:—The screenings shall be free from dust coating and other dirt; 100 per cent. shall pass a ¼-in. screen; and not more than 6 per cent. shall pass a No. 100 sieve." "The compressive strength of a mortar, in which the screenings and sand are in the proportions intended for use, shall be at least equal to the standard strength obtained with sand of the given class."

You will notice that the only allowable use for stone screenings as fine aggregate, is when they are mixed with a proportion of sand. We have had some field tests made in using all screenings for aggregate, and these have shown such doubtful results that it was not thought advisable to replace all of the sand by screenings. It is possible to get good concrete with screenings in laboratory tests; but when tried on a large scale in the field, it is extremely difficult to get a uniform, well-graded material. The proper proportion of screenings from the hard variety of stone will improve a fine-grained sand, but the high costs for careful inspection and proper mixing are likely to make their use prohibitive, except in instances where a good quality of sand is very expensive.

Stone and Gravel

The specification for stone as coarse aggregate in concrete, requires that samples shall be tested before being used in the work. It must be free from dirt and coating of any kind. As a tentative specification we require that stone for use in concrete pavement shall show a "French coefficient" of at least 9 when tested in the standard abrasion apparatus for stone.

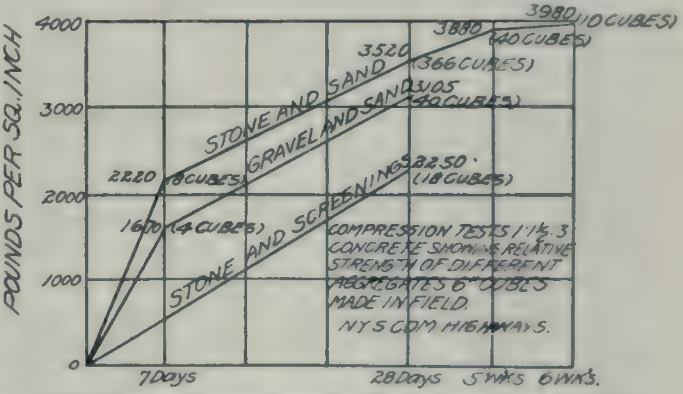
Some few miles of concrete pavement have been built with gravel used as coarse aggregate. These were in sections where a very high grade was available. Such material was all tested and had to meet the requirements of being all composed of sound durable stone, and to be absolutely clean and free from coating. We have found the gravel banks in a large part of the State to run so non-uniform that it was not thought advisable to use this product in concrete pavements, except in limited areas where we have assured ourselves from past experiences that a uniform product can be obtained.

During the routine of the physical laboratory within the past year, the work included the examination and testing of samples representing 1,080,580 barrels of cement, 909 samples of sand and 857 samples of stone. The cements were tested according to the standard methods of the "American Society for Testing Materials." There being no standard tests for sands, the following is a brief outline of the tests and methods employed in our laboratory.

Sand Tests

Gradation.—1,000 grams of the sand to be tested, after a careful weighing, is screened through the ¼-in. No. 6, No. 20, No. 50, No. 100, and No. 200 mesh sieves. After weighing the residue on these sieves, the proportions passing are readily computed. We found from past experience that these are the essential sieves for an intelligent judgment of the gradation.

Voids.—For the determination of the voids, the sand is placed and loosely compacted into a graduated cylinder. This latter has a hole drilled in the bottom, in which a tube is connected leading from a burette filled with water. This apparatus is placed and worked so that gravity causes the water to rise slowly through the sand, forcing the air ahead. By reading from the burette the amount of water which has flowed out, the voids can be computed within a practical degree of accuracy. This method of allowing the water to flow in from the bottom rather than from the top of the sand, eliminates the forming of air pockets, which are extremely difficult to avoid by the latter method.



Curves showing relative compressive strength of 1:1½:3 concrete made from different aggregates. These cubes were all made in the field and stored in field 21 days.

Loam.—For the determination of the amount of loam, a portion of the sand sample is placed in a graduated cylinder, and well covered with water. This is thoroughly agitated, and then allowed to settle from 10 to 24 hours. The loam and silt, which readily separates from the sand, is deposited on top of the sand, and the proportions can easily be computed. This method of loam determination by volume, we believe, is as refined a determination as necessary to fit all practical requirements. It also allows an easy method of checking in the field.

Compression Tests.—The majority of our compression tests are made on 3-in. cubes mixed 1 part cement to 3 parts sand. These are stored in moist air, and broken in 14 days. Four cubes are made from each sand—2 from the natural product, and 2 from the washed. For a comparison of the compression, four cubes of the same size, mixed with standard Ottawa sand and the same cement, are made, stored, and broken under the same conditions and at the same age. The cement used for this purpose is a blend mixed in the laboratory from cements which show similar characteristics under tests. The cement and sand in the cubes are proportioned by volume rather than weight, to avoid the variation of the latter in sands of different character. The cement, although measured by volume, is carefully checked by weight, to eliminate different degrees of compactness in measuring.

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[*] Paper presented to the Association of American Portland Cement Manufacturers.

[†] First Assistant Engineer, New York State Highway Commission.

At present time we are running a series of sand compressions on both 2-in. and 3-in. cubes, for the ultimate purpose of using the smaller size cube. These latter will be made up in lots of four, two of which will be broken at 7 days and two at 28 days. This in many cases will decrease the time necessary for a sand test, and also enables us to observe the relations of the strengths at the different ages.

Of our tests we consider the compression strength of the sand in mortar of major importance; but, as this depends more or less on other determinations—especially gradation and percentage of loam, silt, or organic matter—it is advisable to run a full test in order properly to judge the material.

Occasionally sands are tested for tensile strength; but our experience on the realtion between tension and compression strengths of sand mortars has verified the results obtained by other investigators in the fact that this relationship is so non-uniform that it is absolutely unreliable; and, as we build plain concrete to withstand compression rather than tension, we should test it from that standpoint.

During the course of construction, the concrete highways are under constant supervision of competent engineers. The duties of these men not only include ordinary highway engineering work, but they are required to inspect closely all concrete aggregates. This especially refers to sand and gravel supplies; and when such material shows any great change in character, this being determined by field tests for gradation and loam, such conditions are immediately reported to their superior engineer, who takes steps to rectify them and compel the contractor to secure suitable material.

One of the important checks instituted within the past year on our concrete work was in the testing of the finished product. Engineers in charge of concrete work are required to make 6-in. cubes from the mixed concrete as deposited in the work. Two cubes are taken from every 500 cubic yards of concrete laid; this, in the case of a concrete highway 16 ft. wide and of our standard thickness, represents about 1,700 lineal feet of roadway. These specimens are stored in moist sand near the highway for 21 days, at which time they are sent to the laboratory, where, at 28 days, they are tested for compressive strength. The engineers on the highways are notified of the results of such tests; and this seems to have promoted a friendly rivalry between them to endeavor to obtain the best possible concrete. This pride in accomplishment certainly tends toward obtaining desired results. The chiefs of the department do all in their power to build an excellent type of highway; but, in the end, much depends on the engineers directly in charge.

By means of the above described tests, I know we obtain a good quality of aggregates; and the final tests on the field cubes gives us an excellent check on both material and workmanship. But we also realize that the using of concrete for highway surfacing introduces the factor of making a concrete to resist impact and abrasion. This at present is well taken care of by using a rich mixture; but at the same time we are studying both concrete and mortars from this standpoint, and hope in the near future to be able to devise some method of testing the abrasive and impact resistance of various aggregates.

Mr. Mattimore supplemented his paper by presenting a number of tables and curves embodying interesting features brought out as a result of the tests. The curves, for example, in the diagram herewith reproduced, show the relative compressive strength of 1:1½:3 concrete made from different aggregates. Their main value is that they are the results of field tests, thus giving a good illustration of the concrete obtained in actual practice. This is a good, fair comparison of stone and gravel concrete, as both of these aggregates were of high grade, particular attention being paid to obtain a clean, uniform product passing all requirements for this class of concrete. It will be noticed that the material made with screenings, although showing a fair compression strength, is much below that obtained with a good sand. These latter cubes were made from concrete placed on highways previous to the adoption of the specifications quoted above.

On 1:2½:5 concrete, similarly made from different aggregates, compressive strength tests at 28 days brought out the results shown in the accompanying table.

Aggregates	Age	No. of cubes	Compression Break Lbs. per. sq. in.
Slag and sand	28 Days	16	2000
Stone and sand	28 Days	134	1990
Gravel and sand	28 Days	142	1895
Stone and screenings .	28 Days	28	1740
Coated gravel and sand unwashed	28 Days	48	1170

Complete New Track Entirely Before Putting it in Service

PUTTING new railroad tracks, such as additional mains, into service just as soon as they are safe for operation often proves to be a false economy; and closing the construction accounts before all work properly chargeable to the construction is completed throws an unfair burden on maintenance costs, comments a writer in The Engineering Record.

A few weeks, or often a few days, additional time will probably enable the construction forces to complete work, which, while perhaps not apparent to the operating official, will nevertheless cause considerable loss and additional expense if not done before the new track is thrown open to traffic. In cases where the roadbed is constructed of certain kinds of material, irreparable damage is done by permitting the continuous use of the track, even by work trains, before ballast is applied, or even after only a light ballasting has been effected. In such cases the ties will seat themselves in the roadbed, forming water pockets which will probably constitute a permanent cause of trouble. Tracks put into service before a permanent surface on heavy ballast has been completed are liable to costly injury through bent rails, battered joints or broken ties.

Even after the new track hs been opened to regular traffic for some time, in no case should the work be considered completed until a final raise has been made and the necessary ballast placed to bring the track up to its permanent cross-section. If the track is to be properly maintained, such a raise will very probably be necessary, and the cost of this should be considered a proper charge to the construction account, and not left unjustly to increase maintenance costs.

The Vancouver Club, Vancouver

THIS fine building was erected and completed last year at a cost of $300,000. It is constructed according to the Hennibique system, of reinforced concrete, and is eighty by two hundred feet in dimensions, with five storeys and basement. On the Hastings Street elevation it is faced with Hebron pressed brick and terra-cotta. The other elevations are finished with cement plaster, the site being an inside one. On the first floor there are a large entrance hall, various offices, cloak-rooms, lavatories, bar, reading and magazine rooms. The second floor, which is approached by a wide marble staircase, contains a large dining-room, finished in Austrian oak. A private dining-room, reached by a separate staircase, communicates with this room. On the third floor are the billiard room and card room, the fourth and fifth floors being given over to bedrooms, of which there are twenty-eight, with fifteen bathrooms.

The fine new premises of the Vancouver Club.

The basement has accommodation for a staff of twenty-five persons, with separate dining and recreation rooms. Provision is also made on this floor for bakery and vegetable supplies, wine and beer cellars, and refrigerating rooms. The boiler room, with vacuum cleaning plant and electrical control panels, are also placed on this floor.

A separate entrance on the Hastings Street elevation gives access to the ladies' portion of the club. A third entrance leads to the servants' quarters, and the steward's office controls the supplies which are delivered through this entrance. A freight elevator serves all floors. A large passenger elevator and two dumb-waiters are planned in suitable positions.

The building is heated by steam—with radiators in the small rooms and hot air in the large rooms—with ventilating system in addition operated by electric fans, this being in fact a modified Plenum system.

The furniture was supplied by Messrs. Waring & Gillow, of London, England, and the electric fixtures were manufactured by Messrs. Cope & Son, of Vancouver.

The design of this building was secured in open competition by Messrs. Sharp & Thompson, architects, Vancouver.

Perhaps the greatest defect in the method heretofore generally prevailing, of building highways by issuing bonds, has been the failure to provide for maintenance of the road after it is built. Only in rare instances have officials faced frankly the cost of maintenance and repair of bond-built highways at the time the bonds were issued and before construction began. Maintenance, however, is necessary in order to insure to the community the maximum economic service of a road, and to preserve the investment so that when the bonds are redeemed there will be something to show for the outlay. The cost of maintenance and repairs, therefore, should be studied at the very outset.

Dining Room, looking towards Minstrel Gallery.

Entrance Hall and Lounge.

Advantages in Use of Commercially Hydrated Lime Over Ordinary Lime

By E. W. Lazell, Ph.D.*

EVERYONE is familiar with the fact that when quick-lime is treated with water a violent action takes place, the lumps of lime break up, heat is generated, steam is given off and after the action is completed, a paste or putty remains—the ordinary lime putty used for mortar. The fact that quicklime has changed its form from dry lumps to a wet paste and that heat has been generated prove that a chemical reaction has taken place; or that quicklime has combined chemically with water. It is a scientific fact that when any chemical change or reaction occurs exact amounts of the material are involved. In the chemical change which takes place when lime is quenched with water definite amounts of lime and water are involved; in slaking lime an exact amount of lime unites with an exact quantity of water, forming an exact amount of hydrated lime and it differs from the orginal quick-water is present to satisfy the calcium oxide (lime) then a dry powder will remain. This powder is hydrated lime and it differs from the original quicklime and from pulverized lime in its behavior towards water. When water is added to hydrated lime no heat is generated nor does the material slake, thus indicating that water has no further chemical action on the hydrate.

What is Hydrated Lime?—Hydrated lime of commerce is the dry powder resulting from the treatment of lime with sufficient water to satisfy the chemical requirements of all the calcium oxide.

Necessity for Exact Proportions of Lime and Water.—In the foregoing, emphasis has been laid upon the fact that precise amounts of lime and water react chemically. In other words, 1 lb. of lime requires a certain definite amount of water to form a perfect hydrate. If too little water is used in quenching the lime in the process of manufacture the lime will be burned in slaking and free lime, or lime which is not combined with water, will be present in the hydrate, rendering the material unsound. Plaster made from such hydrated lime will later pop and pit, due to the gradual slaking of the free lime by the moisture present in the atmosphere. Further, mortar made from such unsound hydrate generally works tough and non-plastic. The free, uncombined lime when present to any considerable extent will dry out the mortar, rapidly decreasing its strength and causing it to crumble. Free lime in hydrated lime is a dangerous ingredient and one which will always give trouble.

If too much water is used in the preparation of hydrate the material will be damp and wet, rendering it difficult to handle.

Obsolete Methods of Manufacture.—In the past, three methods were used to produce hydrated lime:

(1) Small pieces of lime were placed in a basket and immersed in water for a few minutes, until slaking began, when they were withdrawn and placed in a heap in order to conserve the heat and prevent the escape of the vapor; the material swelled, cracked and became reduced to a dry powder.

(2) Lumps of lime were placed in a heap and wet at intervals until the mass was equally moistened throughout. The slaking proceeded as in the first instance.

(3) Small pieces of lime were exposed to the air for a number of months and the lime absorbed both water and carbon dioxide from the atmosphere, falling to a dry powder. The powder consisted of dry sub-carbonate of lime containing about 10 per cent. to 11 per cent. of water.

These three methods of dry-slaking lime were crude and unless the greatest care was exercised, the resulting product contained particles of unslaked lime. The hydrate produced by these methods was generally short and possessed poor sand-carrying capacity; in fact, hydrated lime made by any of the above methods was suitable for use in agriculture only and such hydrate should not be confounded with hydrated lime manufactured by modern methods.

Modern Methods of Manufacture.—The modern method of manufacturing hydrate depends upon the addition of a definite amount of water to a predetermined amount of lime. By no other method is it possible to produce a hydrate which will contain sufficient combined water to satisfy the demands of the calcium oxide (lime) present. It is of the utmost importance that all the calcium oxide be in combination with water, otherwise the hydrate will be unsound and unsuitable for building uses. That all the lime be satisfied with water will be insisted upon in any specification which may be drawn for hydrated lime to be used in the building trade, and it is vital for each manufacturer to recognize that the formation of hydrated lime involves a chemical change requiring the presence of exact amounts of lime and water. Since the process is chemical, it requires the same careful supervision as any other chemical process, such as the manufacture of Portland cement. The production and use of hydrated lime have been more retarded by the manufacture of only partly hydrated lime than from all other causes. Any method of manufacturing hydrated lime continually to produce a perfect product must be based upon weighing the lime used and measuring the amount of water added.

Advantages of Hydrated Lime

From the Standpoint of the Manufacturer.—One of the great difficulties in connection with the manufacture of lime is the perishable quality of the product. Lump lime cannot be stored for any length of time without deterioration, thus making the operation of the plant dependent upon the season and the whims of the weather. Kilns must be fired up, damped down or put out, according to the season of the year and the condition of the weather. This unevenness of operation results in a high unit cost. Since hydrated lime can be stored in bins in a manner similar to cement, it is possible to make the operation of the plant more nearly continuous, thereby introducing economies in the manufacture and reducing the cost. The manufacture of hydrate also means a more extended market, as hydrated lime can be used for a number of purposes for which quicklime is not suitable.

Advantages to the Dealer.—Three principal advantages to the dealer are the ease in handling, less deterioration of the product and the freedom from fire risk. These three facts alone should convince the dealer that it is more economical to handle hydrated lime.

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*Chemical Engineer, Portland, Ore.

Uses of Hydrated Lime.—In general it may be stated that hydrated lime is suitable for any use in the building trade to which lump lime can be put, and it would appear that as soon as the material comes into general use, its advantages will be found to far outweigh any disadvantages. The use of hydrated lime does away with the necessity of slaking lime to a paste, thus saving the space required for the slaking bed as well as the labor of slaking. By the use of hydrate it is possible to proportion the mortar so as to have exact quantities present, since this form of lime comes into the market in convenient packages of known weight. This point is always appreciated by the architect and engineer, as it is a well-known fact when lump lime is used, as much sand as possible is added with the result that the mortar is lean and possesses little strength. If hydrated lime is correctly manufactured and the particles of core removed by some process of separation, the resulting product will possess a higher grade of purity than the original lime from which it is made. The product will also be more uniform and these two facts appeal strongly to all users of lime.

Mortar made from Hydrate is Stronger than that Made from Slaked Lime.—In June, 1910, the writer presented the results obtained from an extended series of tests on mortars made from both hydrated lime and lump lime to the American Society for Testing Materials. One of the most important conclusions drawn from these investigations was that the mortar produced from hydrated lime was stronger than that produced from the corresponding lump lime slaked to a paste. This conclusion was to be expected, since it is possible to manufacture hydrated lime by mechanical means under good chemical control, which is more thoroughly slaked than it is possible to slake lump lime on the job. With lump lime, the user is always dependent upon the thoroughness of slaking, and it is well known that unless lime paste is run off and stored for some considerable time, there is no assurance of complete and thorough slaking.

Practically all those who have investigated the strength of lime mortars have recommended the use of hydrated lime in place of lump lime. In Bulletin No. 30 of the U. S. Bureau of Standards, the following statement is made: "The proportion of impurities in hydrated lime is generally less than in the lime from which it is made. In building operations hydrated lime may be used for any purpose in place of lump lime, with precisely similar results. The consumer must pay the freight on a large amount of water, but the time and labor required for the slaking are eliminated and there is no danger of spoiling it either by burning or incomplete slaking. For all building purposes hydrated lime is to be preferred to lump lime. By its use the time and labor involved in slaking may be saved and the experience of the laborer is eliminated as a factor in the problem."

If the use of hydrated lime in the building trade is to be increased, this can be brought about only by the manufacturers of hydrate preparing and marketing only such material as is sound and contains no free lime. There is an increasing demand for hydrate for use in concrete to render the material more plastic and dense. Hydrated lime can be advantageously used in all cement plaster and stucco to make them work smoothly and give a more pleasing color. In all these uses the soundness of the hydrate is the paramount requirement. No one would think of using unsound cement—why then, should they expect to use unsound hydrate?

The market for hydrated lime is present and a concerted action on the part of the lime manufacturers to exercise the care necessary to make a thoroughly hydrated lime will result in a more extended use of the material. It is to be hoped that the manufacturers will direct their energies along this line.—Concrete-Cement Age.

A Mast and Boom Concreting Plant

A unique plant for mixing and placing concrete at Fort Crockett, Galveston, Tex., is illustrated in Fig. 1. The work under construction consisted of a large number of concrete buildings, placed along a line about 2,000 ft. long. As buildings contain no massive concrete, but consist mainly of thin walls and floors, a portable type of plant was desired in preference to chuting from a number of towers. A small tower and plant, supported on a flat car, was first considered, but it was finally decided that the plant shown in Fig. 1 would be more efficient, due mainly to the elimination of chutes and the consequent loss of time which would necessarily result in changing them.

By referring to the illustration it will be noted that the plant consists essentially of a braced mast with boom attached. The mast, which is a 12 x 12-in. timber, is pivoted at both top and bottom so that it can be turned through an angle of about 300 deg., or until it comes in contact with the inclined braces. The boom, which also is 12 x 12 ins., in section, has a length of about 60 ft., being rigidly connected at right angles to the mast, at a height of about 45 ft. It is supported from the top of the mast, at three points along its length, by means of rods equipped with turnbuckles. Along the top of the boom there is a steel track upon which the trolley runs (see Fig. 1).

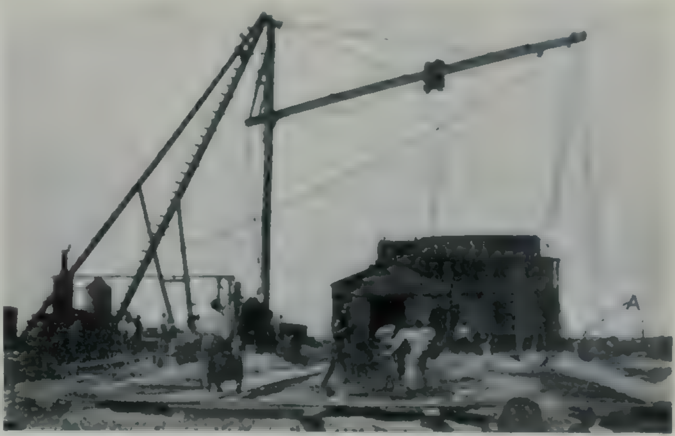

Fig. 1.—View showing mast and boom concreting plant in operation. Note arrangement of lines and positions of hoisting engine and mixer.

The mast is mounted at the apex of a large triangular frame, the inclined braces from the top of the mast being carried to the other apices of the triangle. This supporting frame is carried on three wooden trucks, located at the apices of the frame, each truck being fitted with four solid wooden wheels of very wide tread.

The equipment on the frame consists of a "Smith" mixer, mounted near the apex of the triangle at the base of the mast, together with a hoisting engine and boiler and a crude oil tank, placed at the base of the triangular frame. The boiler furnishes steam both for the mixer and for the hoist.

In operating, the bucket is placed under the discharge end of the mixer. After being filled, it is raised to a height just sufficient to clear the forms and other obstructions, and the trolley then run out along the boom the desired distance. The bucket is then lowered and dumped, after which it is brought back to the mixer by reversing the operations. It was necessary to use great care in performing these operations, especially when the bucket was suspended at a considerable distance from the trolley (as in Fig. 1). If the horizontal motion of the trolley was started or stopped too quickly a dangerous swinging of the bucket resulted.

The arrangement of the cables, by which the bucket and trolley are operated, is shown in the illustration. The boom is moved laterally by a modified tag line. By means of this arrangement one man can handle the boom with ease, by holding the line at the middle bight, at the point where it is shown tied to the stake (at A, Fig. 1). The entire plant is moved by block and tackle attached to a dead man and to the niggerhead of the hoist.

The plant is also used to drive piles, a pair of leads and a steam hammer being suspended from the boom for this purpose. After being placed the leads are held in position by spuds. With this arrangement it is easy to spot the hammer in position for driving the piles.

The equipment, which is described in a recent issue of Engineering and Contracting, was designed and used by James A. McGonigle & Son, contractors, of Leavenworth, Kan.

Irregularity of Employment: Its Effect on the Workman and on the Contractor

IRREGULARITY of employment is a demoralizing factor with which both the employee and the employer are now contending. In certain kinds of work it is reasonably certain that workmen will be able to secure fairly steady employment, while in other lines men have become accustomed to viewing such employment as temporary. In a measure, the rate of wage is based on the duration-of-employment factor, and the employer attempts, by wage adjustments, to give proper weight to it. It is doubtful, however, if contractors realize the extent to which irregularity of employment affects the efficiency of workmen. In building construction it is such an important factor that contractors are beginning to realize a better solution of it is necessary if they are to maintain success in such work. As building work is now conducted it is customary to retain the services of workmen only until they have finished their work on a particular building. In fact, even foremen, and sometimes superintendents, are employed only for a certain job. In general, it is practically impossible to enforce such corrective measures as the employer deems necessary from time to time, because the employee does not fear discharge, realizing that at best his employment is only temporary. The average employee who follows building work reasons that he can only hope to secure employment during a part of the year, and he often reaches such a state of mind that he does not even desire steady employment. The different wage scales adopted as standard in various cities also tend to increase his unrest. Most general contractors endeavor to keep throughout the year a certain part of their working organization; they have in their employ certain superintendents and foremen whom they endeavor to give permanent employment—many of them, however, evidently do not realize that a serious attempt should be made to retain the most efficient workmen. It is a known fact that men become attached to certain foremen and will make sacrifices to remain under their direction. We have known foremen whose greatest asset was their ability to assemble and retain an efficient force of workmen personally known to them.

In an attempt to solve this problem the Aberthaw Construction Company, which specializes in reinforced concrete building construction, has issued to certain of its more efficient workmen a "Record of Service Book." The holder of such a book is guaranteed a certain rate of wage so long as he remains in the employ of the company—no matter in what section of the country he is employed. The company also agrees to give the holder of a service book employment whenever there is a position open which he is qualified to fill; and the man is kept informed to new work as it comes up. The method used by the superintendents in signing workmen "in" and "out" on a job tends to spur the men to efficient service. When a man presents his book on a new job the superintendent fills in the left-hand page, giving the date on which work is started; when the job is completed the superintendent signs a statement that the man has completed his work on a given date. The book is then sent to the main office, where an officer of the company signs a "sticker" attached to the right-hand page, which indicates that the workman is in good standing. The service book contains a definite description of the man, to prevent its being transferred, a carbon copy of this description being kept at the main office.

It has been found that the use of this system has been effective in retaining good men and in making it easier to handle them to the best advantage. The possession of a service book by a workman is a recommendation of proficiency, and it can be used as such in case the workman is not given steady employment by the company, and finds it necessary to seek work elsewhere. Activity of this kind, which tends to encourage regularity of employment, is to be commended; and it is encouraging to note that more attention is being given to this important factor.—Engineering and Contracting.

The order of turning in the hand mixing of concrete should be so regulated that the last turn made will place the material in a single pile, at or near the centre of the board, preparatory to its removal to its place in the work.

New Immigration Buildings at Vancouver

THE view shown herewith is the Dominion Immigration Department's new building at Vancouver, which is now nearing completion. This building occupies a frontage on Burrard Inlet. It is 212 feet long, 64 feet wide, and 75 feet high. It contains four storeys over its whole area, and a small storey in the central position for the operation of the ventilating machinery.

The interior construction is of steel frame, having all floor beams bearing upon the external walls, which are carried up in solid brickwork varying in thickness from 25 ins. to 13 ins. All floors are of continuous reinforced concrete slab.

The chief feature of the building is its foundation. The level of the basement floor being only 4 ft. 6 ins. above extreme high water mark, and approximately one-half of its area over the water at high tide, a very solid and heavy foundation has been provided. The whole building stands upon reinforced concrete piles, the sea retaining wall having four rows on 3 ft. centres, and the remaining walls two rows. All interior columns are carried upon a nest of piles capped with concrete 2 ft. 6 ins. thick, and reinforced with 1-inch square bars in both directions. The whole of the piles were cast on the site. They are 16 ins. in diameter and octagonal in section, of an average length of 25 feet. The bottoms are pointed with a forged shoe strapped to the reinforcing steel, and all piles driven to refusal. A 3,500-lb. hammer was used for driving the piles and no excessive crushing was permitted, all heads being finally cut off to a uniform level and the steel bonded to the reinforcing bars of the foundation caps.

The accompanying photograph was taken during the process of casting the piles and conveys some idea of the number of piles used and the class of foundation upon which the building stands.

The sea retaining wall extends to a depth of four feet below low water mark. It is 11 ft. thick at the base, and 4 ft. thick at the top of mass concrete, with ends returned in similar construction as far as high water mark.

Creosoted fir sheet piling is provided at the foot of this wall, and will be cut off at ground level upon completion. This line of sheet piling was put in with 4-in. tongued and grooved fir, well supported from the bank, and formed a water-tight cofferdam for the construction of the sea wall at all periods of the tide.

The exterior of the building is executed in Kilgard pressed bricks with sandstone dressings, with a granite plinth extending 3 ft. 6 ins. in height the entire way round. The roof is covered with asbestos slates, and the over-hanging eaves, carried upon brackets, give the building a proportionate effect and a pleasing appearance.

Three staircases are provided, all of steel, two ex-

The Dominion Immigration Department's new building at Vancouver.

tending the full height, and there are two dumb-waiters and one elevator in the centre of the building. Suspended metal ceilings are provided throughout. The floor finish is in cement, marble terazzo or B. C. fir, according to the requirement of the various rooms. All stair treads are marble, and a marble dado 3 ft. high surrounds all walls to stair wells.

The heating and ventilating equipment is provided upon most modern systems, there being two tubular boilers, rated at 70 h.p. each, installed, and 11,000 square feet of radiation distributed over the building.

The design is by the Chief Architect of the Dominion Government. The general contractors are Snider Bros. & Brethour, Limited, of Vancouver. The supervising architect is Mr. E. E. Blackmore, Vancouver.

The structural steel was supplied by Messrs. J. Coughlan & Sons, and the heating, ventilating and plumbing was installed by Messrs. Barr & Anderson, Limited, both of Vancouver.

Railway engineers in countries where intense heat is experienced may learn something from the practice of the Southern Pacific Railway. The houses of the sectionmen—platelayers—are made of double walls of hollow tile, which keeps the houses cool by day, but warm and comfortable by night. Trees are also planted around the quarters, to provide shade, and, in addition, to make them more homelike. Their families live with the men, there being accommodation for from four to ten families in each block of buildings.

In lowering a large steel storage tank to its foundation in a deep pit, Honolulu engineers built up a temporary resting place of blocks of ice, and then, after the structure had been properly centred, melted the ice uniformly with steam. The reservoir is 24 ft. in diameter, 25 ft. high, weighs 14 tons, and has a capacity of 80,000 gallons.

Railroad Construction in Quebec

The C. P. R. have just constructed near Dorval, P. Q., a temporary spur line of about two thousand feet to the new Cavalry Remount Camp which the Government is building in order to assemble and sort out the horses coming from all parts of Canada before being shipped across the seas to the war. The corrals, hospital, barn and quarters for the men are extensive, so that the C. P. R. had to build a platform a thousand feet long. Accommodation is being provided for three thousand horses. Mr. R. McKillop, the C. P. R. engineer, had the satisfaction of seeing the whole thing completed in six days.

Building the C.P.R. line to the remount camp.

The Welland Canal

For years the interest of those who follow the engineering of waterways has been centred in the Panama and the New York State Barge canals. They were tremendous projects, replete with details of the greatest interest to engineers, both in design and construction. Now that the work of building them is drawing to a close, interest will probably shift to the construction of the Welland Ship Canal, on which the Dominion Government will spend $50,000,000. And well will it deserve the attention previously given to Panama and to the New York work. Only those who have had occasion to look into the Welland designs carefully appreciate fully the magnitude of the enterprise. In length it is not noteable. Its locks, however, will stand with the great ones of the world. They are to have clear inside dimensions of 80 x800 ft., with 30 ft. of water on the sills, while each of them will have the great lift of 46½ ft. At Thorold will be constructed a flight rivalling that at Gatun, for though the locks themselves will not accommodate as big a vessel the lift will be greater. At this point there will be three of them in flight, each with a lift of 46½ ft., or a total lift of 139½ ft. Moreover, as at Gatun, the flight is double, one for upbound and the other for downbound vessels. In details the locks will be very interesting. The most unusual feature will be the use of swinging single-leaf gates. The adoption of this design followed only after a most careful study of all other alternatives. It would not be surprising if the Canadian peninsula just west of the Niagara River should become a Mecca for canal engineers during the next few years.—The Engineering Record.

The total cost of wood lathing should be about $8.64 per 100 square yards. Metal lath runs in weight from 2.65 to 2.84 lbs. a square yard, and the cost varies from 15 cents to 20 cents a square yard. The total cost per 100 square yards for metal lathing should not be much over $18.50. These figures include the cost of scaffolding and are on a 6,000-sq. yd. basis.

A large wooden pipe at the hydro-electric works at Eugenia, Ont., collapsed last week. The pipe was under a 20-ft. fill, and the weight of the fill crushed the pipe. The mishap will necessitate the clearing of the fill, and the wood pipe will be replaced with one of concrete. It is expected that this will take three months to complete, and it is unlikely that power will be turned on before August next.

A hint to contractors, builders, and property owners generally, is embodied in the case just disposed of in the Court of Review, Montreal, when their Lordships unanimously reversed the finding of the lower court in the case of Chevalier vs. Tompkins. Briefly, the facts are as follows: Chevalier, a bricklaying contractor, sued Tompkins for $190.50, the balance of the contract price for certain brickwork done. The defendant refused to pay because the work was done badly and the building condemned by the building inspector. It was held that since the plaintiff built the wall knowing that conditions would render his work useless, he should not have built it, and that therefore his action to recover the contract price could not be upheld.

Sir John Jackson, M.P.—Engineer-Contractor

Specially Written by the London (Eng.) Correspondent of The Contract Record

AMONG contractors for public works, Sir John Jackson holds a high position, and if his firm, Sir John Jackson, Limited, is not the largest it is at least one of the two largest in the United Kingdom. He was born at York in 1851, educated at York and Edinburgh Universities, and his first contract came to him some twenty-five years later, and from the date of that he has never "looked back." One huge undertaking has followed another, and he is the very exemplification of the saying that "nothing succeeds like success." Space allows of little more than a bare catalogue of the more important of his works.

The completion of the Stobcross Docks at Glasgow was his first big contract, and the four years allowed for the job were reduced by him to three, in spite of the fact that the docks were constructed in quicksands. Then came the extension of the Middlesburgh, the Hartlepool and the North Sunderland Docks, the extension of the Fort at the end of the Admiralty Pier at Dover, and the completion of the last eight miles of the Manchester Ship Canal. The Dover Commercial Harbour, the foundations of the Tower Bridge, the docks and basins at Swansea and Methil, the breakwater and docks for the Burntisland Harbour Commissioners, and the deep dock at Barry followed, with many other works of an incidental kind.

Sir John Jackson

Among the undertakings of a gigantic nature carried out by him —or by his firm, which is much the same thing—precedence so far as importance goes must be given to the extension of the Admiralty Works at Keyham, Devonport. The cost of this undertaking was nearly £4,000,000, and the arduous nature of the work including the carrying down of foundations to solid rock, which was found in some instances only after going 110 feet into the mud—entailed an eight-years struggle. Another Admiralty job was the construction at a cost of some £2,000,000 of the Naval Harbour and Graving Dock at Simon's Town, Cape Colony. For Spain he has built the new arsenal at Ferrol; for Chili the railway across the Andes (joining Arica on the Chilian coast with La Paz, the capital of Bolivia) at a cost of £3,000,000; for Turkey the first part of the irrigation works in Mesopotamia which were designed by Sir William Willcox and estimated to cost over £18,000,000. This first part is the Great Hindiat Barrage across the Euphrates, which was opened recently by the Vali of Bagdad.

Now in hand by the firm are water supply and irrigation works in the Lebanon district of Syria; works in connection with Singapore Harbour for the Government of the Straits Settlements; and the new breakwater at Victoria, B.C., for the Dominion Government. Certain surveys and proposals to the Russian Government were made by Sir John for a second Trans-Siberian Railway, estimated to cost £20,000,000, but the war has stopped consideration of the scheme.

The light of a man of such experience and ability as Sir John cannot, however retiring the individual may be by disposition, be hidden under a bushel, and it is only to be expected that his advice and assistance have been sought after by Governments, corporations, companies and individuals in all parts of the world. Reference has just been made to the proposed second Trans-Siberian Railway scheme. When the French engineers were discussing the feasibility of bridging the Channel from Dover to Calais Sir John was invited to attend the conference in Paris, and he was also invited to assist (on behalf of the Americans) at the conferences held for the consideration of the subject of the Nicaraguan Canal. When the British Government decided to inquire into the military preparations and other matters in connction wth the South African War, Sir John was appointed a member of the Royal Commission. These are but a few of the many instances that could be quoted.

In the War which at present bids fair to devastate Europe, the firm of Sir John Jackson is bearing its share of the burdens which are cast upon every member of the community. Its share may be of some profit to the firm, but that does not detract from the patriotism that prompted Sir John to offer the services of himself and his Junior Directors to the War Office. That the offer was accepted goes without saynig, and the firm was appointed as Superintending Engineers to the War Department immediately under Major-General Scott Moncrieff, Inspector-General of Fortifications. In the first instance they supervised and carried out work to the value of about half a million sterling, without any remuneration. Among the first works given to the firm was the construction of quarters at Grantham, Ormskirk, Purfleet for the Home Troops, and later on Salisbury Plain for the Colonial Troops. "So able an administrator as Lord Kitchener," it has been said, "saw at once that the ordinary army routine of contracts passing through half a dozen hands before a brick could be laid or a stick put up must be set aside and the customary red tape methods abandoned. Accordingly, subject to supervision by the Inspector-General of Fortifications and a final appeal to himself, Lord Kitchener gave Sir John Jackson what might practically be called a free hand. Nor have the War Office had cause to regret the new procedure. For not only has the experience of Sir John's firm saved the country thousands of pounds, but by working in many cases night and day and seven days a week, notwithstanding in some instances the shortness of labour, Sir John Jackson, Limited, have made wonderful progress with the hutments, the value of work done in one month on the Salisbury work alone being close upon half a million pounds sterling." Particulars of the work being done on Salisbury Plain would make a score of interesting articles. Villages have literally sprung up and a town is being constructed that will eventually accommodate eight times the population of Salisbury itself. Huts have been going up at the rate of two hundred a week! A special water supply with pumping station and an electric lighting installation are among the manifold works in connection with the "camp," together with a 4½-mile railway line, including a lattice-girder bridge 140 yards long, necessitating deep piling through the mud 40 feet to the chalk, which was completed and traffic running with twenty days. At Grantham, too, a line of 2½ miles in length was laid in 3½ days! Both feats seem almost incredible.

Many are the honors which have been conferred upon Sir John. He can place after his name C.V.O., **L L.D.**,F.R.S.Edin., M.P., and J.P., while he holds the Grand Cross of Naval Merit (1st Class) of Spain, and is a Member of the Chilian Order of Merit (1st Class). He was knighted in connection with the Manchester Ship Canal work; and he received the Companionship of the Victorian Order on the completion of the Simon's Town harbour and dock, the Grand Cross of Naval Merit on the completion of the Ferrol Arsenal, and the Chilian Order of Merit as a reward for his railway work in Chili. His recreations are yachting, cycling and motoring, and he is a member of the Royal Yacht Squadron and the Royal Western Yacht Club, and Commodore of the Royal South-Western Yacht Club. He represents Devonport and East Stonehouse in Parliament, as a Conservative.

"A great engineer, a great contractor, a great traveller," it has been said of him, "few men have led a busier or more active life, few men's work will leave a more indelible mark on the history of things which count and things which last. Essentially a man of action Sir John never lets the grass grow under his feet. When once he decides to do a thing he does it with all his might. Like all men of business, he does not care to waste time in talking that leads to nothing, but will readily listen to a reasonable statement, and is fair and just to all. He soon forms an opinion of a person and is seldom wrong in his judgment. A broad-minded man in every sense, Sir John is generous to a degree, and never so happy as when entertaining his friends. His kind-heartedness is proverbial. He likes calling a spade a spade, and often delights his audiences by speaking his mind freely on matters on which he feels a word in season will do good morally and physically. A hard worker himself, he has no use for shirkers, and a man who is not prepared to pull his oar in the boat need not apply for work to Sir John Jackson. Honesty of purpose and strict attention to business, combined with many natural gifts, have placed him at the head of his profession, and right well does he deserve the brilliant success he has achieved."

Free sand imported from Europe is being used in the construction of the new subways in New York City. This is not because suitable sand cannot be obtained in this country, but because the war in Europe has cut down the cargoes which steamships ordinarily bring from the other side of the Atlantic to such an extent that it is necessary for many ships to come over in ballast, and they have been using beach sand as ballast. Upon arriving in New York this sand is discharged to make room for the returning cargoes, and is practically given away by the steamship company to anyone who will haul it away and dispose of it.

Maintenance of Concrete Pavements

THE following recommendations as to proper methods of maintenance of concrete roads, given by Cement World, are based on a survey of the results of up-to-date practice in various parts of the country:

1. The imperfection to be repaired should be thoroughly cleaned by brushing until all loose particles have been removed.

2. If the imperfection extends through the pavement and exceeds 6 inches in breadth or diameter, the sides should, after cleaning, be painted with cement grout, and the cavity filled with concrete of the same mixture and consistency as were used in building the original pavement. If a replacement, the excavation should be back-filled with gravel, well tamped, and the concrete properly reinforced. The repaired portion should be cured by being kept moist for at least four days, and protected from traffic until thoroughly hardened.

3. When a hole does not extend through the pavement, but exceeds ½ inch in depth, it should be carefully cleaned and dried, and then painted with hot tar. The hole is then filled with stone. Several sizes should be carried by the repair gang, the object being to use in any given hole a size of stone large enough to reach nearly from the bottom of the hole to the surface, but never to use stone exceeding 2½ in. in diameter. Where large sizes of stone are used, voids should be carefully filled with smaller sized stone and the whole tamped or rolled into place. Hot tar is then poured over the patch, gauging the quantity so that the tar will be absorbed without any large excess.

4. Holes less than ½ in. deep, cracks less than 1 in. wide, and expansion joints from which the filler has wholly or partly disappeared, should be cleaned, dried, and filled a little above level with hot tar, on the surface of which gravel or granite, from ⅛ in. to ¼ in. in size, should be spread from a shovel.

5. Refined coal tar should be used, having a specific gravity not less than 1.18 nor more than 1.25 at 77 deg. F. The tar should be heated to from 225 deg. to 250 deg. F. at the time of application, and may be applied by means of conical-shaped buckets with opening at apex, or by using a sprinkling can. Sand or screenings graded from ⅛ in. to ¼ in. should be spread over the surface, before the tar has cooled enough to prevent the sand from becoming firmly embedded therein to form a permanent wearing surface.

Home-Made Cements

One of the simplest hard cements is the well-known mixture of litharge and glycerine made to a stiff paste. It sets as hard as a rock and is oil-proof. A solution of water-glass mixed with powdered calcium carbonate serves the same purpose. A mixture of boiled linseed oil and fire clay resists acid better than most cements, though sulphur melted with glass powder is also ranked as very resistant to chemicals in general. A good stone cement is made by mixing two parts of magnesium oxide, one part of magnesium chloride, powdered stone to suit as filler, and water to make a stiff paste.

Hydro-electric plants in New England are producing more than 2,000,000,000 kw.-hr. of energy, which, if produced by coal, would mean the annual consumption of 3,000,000 tons of that fuel, according to figures given by Henry I. Harriman, President of the Connecticut River Power Company.

Personal Mention

Mr. Angus Smith, City Engineer, of Prince Albert, Sask., has gone to Fielding, Sask., on his annual vacation.

Mr. Thomas Hooper, whose photograph we reproduce herewith, is a well-known Vancouver architect. A native of Devonshire, England, where he was born fifty-eight years ago, he came over to Canada early in life, and engaged in contracting and building in Manitoba for five years. He went to British Columbia in 1886, and shortly afterwards was appointed Supervisory Architect to the Provincial Government. Mr. Hooper has built a number of the most prominent buildings in British Columbia—notably, at Vancouver. He is a member of the Pacific Club of Victoria and of the Terminal City Club, Vancouver.

Mr. Thomas Hooper, of Vancouver

Gunner A. I. Richardson, of the 5th Battery Canadian Field Artillery, who was killed in action at the end of April, graduated from McGill University three years ago as an architect. He was on the staff of Hogle & Davis, and of Brown & Vallance, and on the outbreak of war left Saskatoon and joined the 21st Westmount Battery in Montreal. Lance-Corporal W. H. MacNamee, killed in action, was at one time Montreal manager of the Philip Carey Manufacturing Company.

Mr. J. H. Hughes has been appointed electrical engineer of the Eastern lines of the C. P. R. in succession to Mr. J. A. Shaw, who has been made electrical engineer of the entire C. P. R. system. Mr. Hughes was formerly assistant to Mr. Shaw, and has been several years with the C. P. R., prior to which he was on the staff of the Montreal Light, Heat and Power Company.

Mr. Percy Booth, Montreal, is the winner of the George Creeford Browne scholarship in architecture at McGill University. This is of the value of $500, one condition being that the holder travels for the study of his profession for not less than three months and reports the results of his study on his return. Mr. A. B. Darbyson, of Montreal, won the scholarship last year, the present being the second year of the competition.

Mr. Joseph Race, City Chemist and Bacteriologist, Ottawa, has been requested by the Board of Works to undertake the examination of all materials used in connection with asphaltic roadway construction. Mr. Race has had previous experience of roadway work in England. He assisted in the preparation of the specifications which were ultimately adopted—practically without modification—by the Roadway Board of England.

Dr. T. A. Starkey, Professor of Hygiene at McGill University, has been appointed Major with the Canadian Overseas Contingent. He will organize the sanitary section of the Army Medical Corps, the unit consisting of 27 officers, non-commissioned officers, and men. Major Starkey will have under his charge the sanitary arrangements along the lines of communication with the British forces as they advance.

Mr. R. Leslie Meek, engineer for the Canadian Stewart Company at Fort William, Ont., and Mr. L. F. Grant, builder and contractor, of the same city, have gone to Kingston to join their corps. Mr. Meek and Mr. Grant volunteered some time ago for active service with the engineering corps of the Second Contingent.

A consulting engineer will be appointed by the City of Montreal to assist Mr. P. Mercier, Assistant Chief Engineer, while Major Janin is on active service. The names of two well-known local engineers, Mr. M. J. Butler and Mr. P. W. St. George, are being mentioned in connection with the appointment. It is thought probable that Mr. Butler, who is now connected with the Armstrong-Whitworth plant at Longueuil, will succeed Major Stuart Howard as head of the Sewers Department.

Mr. Thos. Adams, of the Commission of Conservation, Ottawa, spoke recently in Winnipeg on the subject of Town Planning. Mr. Adams' address was aided by a map showing the character of a town planning scheme in Great Britain involving 5,900 acres. He congratulated Winnipeg on the work which the Town Planning Commission had performed in the last four years. He said that the city offered a splendid field for such planning. He commented on the city's wide thoroughfares, and said that for this reason the improvements necessary in the central part of Winnipeg were very small. In closing, Mr. Adams said: "Under the proper scheme of planning throughout Canada we should be able to apply sanitation and hygiene in every city and village in the country. We have had a great heritage handed down to us, and we have a still greater heritage to hand down to the next generation."

Mr. Thomas Adams, of Ottawa

Mr. James A. Farrell, President of The United States Steel Corporation, was a recent visitor in Vancouver. In speaking before the Canadian Club, he said that his company had great faith in Canada and was backing up its faith with real money invested in the steel plant now under construction in Ontario, just across from Detroit. Mr. Farrell was most optimistic about the present trade outlook, and said that since the steel and iron business is a trade barometer it would be of interest to know that the company's mills were working to seventy per cent. of their capacity, and that this was an increase over the January operations of one hundred per cent.

Mainly Constructional

East and West—From Coast to Coast

It is believed that the Canada Cement Company will commence operations shortly at the cement works at Shoal Lake, Ont. The company have secured a Government order for 2,500.000 barrels to be used in the Welland Canal extensions. Next to the Panama Canal contract this is the largest order for cement ever given. Half the order is said to be for marl cement.

The Lock Nut & Specialty Manufacturing Company expect to commence operations in Hamilton, Ont., on June 1st, and before the year is out it is probable that two or three hundred men will be employed. The company will manufacture lock nuts and automobile wheels. Officers have been elected as follows:—M. J. Dunham, President; J. T. Stroud, Vice-President and Secretary-Treasurer; and C. V. Langs. Attorney for the company.

All work on the new Parliament Buildings at Winnipeg is to be stopped at once, while the Government make a thorough inspection of everything that has been done on it so far. An announcement to this effect was made at a session of the Royal Commission by the Hon. A. B. Hudson, Attorney-General. It was decided that the Commission should appoint a representative to be present when the Government prosecute their inquiries. Mr. John Woodman, architect, will be asked to act in this capacity.

The Dominion Bridge Company have lately received two bridge orders, involving an outlay of one million dollars. One of the new structures is to be built in New Brunswick, and the other in British Columbia. It is stated that work will be begun immediately on the bridge contracts, which will in no way interfere with the big shell orders already received by the company. The bridge section of the company has been working at low pressure for nearly a year, the shell manufacturing having been done in other departments of the plant.

Officials who were sent to British Columbia to investigate the proposed manufacture of brass in Canada through the refining of both copper and zinc in this country, have reported that it is quite feasible, and should be a profitable industry if aided at first by a small Government bonus. Brass is very necessary at present for the manufacture of munitions of war, and it is stated that the price could be lowered if it were manufactured in Canada. Britain would purchase part of the output. It is claimed that a saving of two cents a pound on copper for two years, with a demand like that existing at present, would pay the cost of establishing a refinery.

Seventeen million gallons of lake water a day will soon be available by conduit and pressure pipe in the city of Victoria, B.C. A ribbon of steel and concrete nearly forty miles long now connects Sooke Lake with Victoria, and although the system will not be in full operation until properly tested the Sooke water-works are practically finished. The work has cost more than the sum allowed in the original estimate, and the ratepayers have authorized an expenditure up to three million dollars, to include land damages; but it is hoped that this figure may be reduced eventually. The Water Commissioner expressed his satisfaction with the expedition shown by the Pacific Lock Joint Pipe Company, which has completed its section of the contract in less than the stipulated time.

Mr. J. L. Weller, Chief Engineer, still holds to his assertion that the Welland Ship Canal will be ready to open in 1918. Although the war has handicapped the work to some extent, and delayed the letting of the remaining contracts, the progress made on the great waterway is entirely satisfactory. Summer activity is well under way on Sections 1, 2 and 3. While enough excavation has been done on Section 3 in Thorold to change the whole face of the country affected, the work is really little more than started. In parts of this section it will be necessary to go down eighty feet more, partly through solid rock. At Port Weller more progress is to be seen. The walls of one lock are well up, and the water culvert in the lock wall is taking shape. The Boone Construction Company has taken a contract for dredging in the harbour, and while only one dredge is at work at present others will be on the job shortly. A 25-in. suction dredge will be employed at Section 5.

Ceresit Water Temple at the Panama-Pacific Exposition

THE Ceresit Water-Temple, illustrated herewith, stands in the Palace of Machinery at the Panama-Pacific Exposition. It is the exhibit of The Ceresit Waterproofing Company, Chicago.

In this exhibit the architect, Mr. E. B. Brown, of Stockton, Cal., has successfully accomplished the difficult task of combining beauty with utility.

The fountain at the pinnacle of the Water-Temple pours a constantly flowing stream of water over the cement dome, and this water runs along the eaves and then down through the eight supporting pillars of the Temple to its base, from which point it is pumped back to the roof again

There are plate glass inserts in each pillar, and the interior of each is lighted with concealed electric lights showing a miniature Niagara between walls of ceresitized cement; while the roof of the same material further illustrates the effective and permanent waterproofing qualities of Ceresit.

The Ceresit Water Temple.

A semi-indirect electric light gives a restful and pleasing effect inside the Temple, while the drinking fountain in the centre refreshes the tired and dusty sightseer.

The Ceresit Water-Temple stands 16 feet high and is a prominent feature among the many exhibits in the Palace of Machinery.

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The Part of the Governments in Leading Constructional Enterprise

DURING the last few months we have adduced many arguments in favor of the idea of undertaking construction now, at a time when everything is on the side of the man with money to spend, when the country's greatest need is employment and activity, when every enterprise showing constructional purpose exerts an encouraging influence upon the community, when labor is so plentiful that one can discriminate at will, when the prospective builder has the whip-hand in negotiating for building sites, when the materials of construction are obtainable at rock-bottom prices, and contractors have reduced the art of estimating to an exact science. Many there have been who have concurred in these views, but it has remained for Mr. James McDiarmid. of Winnipeg, to find the exact balance.

Mr. McDiarmid, whose letter is published in this issue, writes commenting upon the letter by Mr. W. A. Mountstephen, of London, England, published in our last issue. He tells us of the situation in the West—how many of the towns and cities have been developed two years ahead of their requirements. He reminds us that business and philanthropy are a bad mix, and that the capitalist cannot be expected to build pro bono publico. He makes a forceful plea for the provision of employment, and for the promotion of business enterprise by way of governmental enterprise. He suggests the construction of public buildings and the undertaking of comprehensive highway schemes.

To these views The Contract Record subscribes unreservedly. Months ago we urged that the Provincial and Federal Governments should take a more active part in maintaining the general business stability of the country. In a series of editorial articles we pointed out the part that the authorities could take in placing highway construction and the erection of public buildings and other such undertakings under way at a time when the depression caused by this great world war was having such telling effect. The suggestion now revived by Mr. McDiarmid received particular emphasis in our issue of December 10th, when, in commenting editorially upon the Central Technical School (described in the above issue), we observed:

> "In this magnificent building, erected at a cost of some two million dollars, Toronto has a standing monument to progressiveness, and material proof of an understanding of present-day requirements. The example is one which may well be followed, particularly in Western Canada, where the facilities for technical education are so lamentably few. At this very time, when business conditions are quiet, funds are hard to obtain, and building work is slackening, an impetus to the activities of many a community throughout the country might be given by the technical school movement. The erection of a building on the Toronto scale would not have to be considered in many cases, and in some instances the expenditure might even be reduced by a couple of ciphers. Funds may be scarce, but money is always obtainable for sound, legitimate projects that have substantial backing, and contracts for such buildings could not be awarded at a better time than the present. The employment which these undertakings would provide for the working classes would be a Godsend to the country."

It must not be taken for one moment that we are disclaiming the "Build-Now" policy: we are heart and soul with those who advocate building now; but we are not altogether in sympathy with those who contend, illogically, that a wholesale investment in general building will pay at such a time as the present, and this point is well taken by Mr. McDiarmid. If it were possible to induce speculators and men with capital to start building operations on anything like an appreciable scale, it would not be long before we should find the country loaded down with failures. The constructional interests can only expect a degree of the success or failure which attends the undertakings with which they are identified.

One is not justified in going further than presenting—logically, clearly, forcefully—the best arguments —enduring arguments—as to how and why a man should spend his money. One may cry from the housetops that the factory owner, the hotel proprietor, the dweller in the city and the town, the artisan—all these and others, provided they have the money available—can build now with profit and patriotism; but one must retire into an obscure corner to suggest to any thinking community that anything like lavish expenditures—building, municipal or otherwise—are warranted or advisable.

Mr. McDiarmid's suggestion of "a public highway from the Atlantic to the Pacific" has much to commend it. Thanks to the efforts of the B. C. Highway Commission, a start has already been made upon such a project at the British Columbia end. Now is the time for such an undertaking to be prosecuted; now is the time for the Dominion Government to take the lead in authorizing reasonable expenditures on this and other legitimate public works. Such undertakings could not fail to be well received by the country at the present time, and they would redound to the advantage of all later on.

LETTERS

"The West Must Look to the Government"

Winnipeg, May 28th, 1915.

Editor, The Contract Record:

While I agree in part with the arguments adduced by Mr. W. A. Mountstephen in the letter published in your last issue, I cannot help thinking that the "Build-Now" idea can provide only a partial solution to the great problem of the unemployed in the western provinces. One unbiassed by personal considerations must feel that the advantage of cheap building material has not been greatly in evidence so far.

A general "Build-Now" policy has little in its favour as a business proposition. A man with capital to place is not expected to be a philanthropist; he expects a fair rate of interest, and that interest promptly paid, besides having a reasonable security for his investment. No one has a stronger belief in the future of this country than I, but I cannot see how an investment in general building will pay at this time.

Whatever the causes which led up to the present state of affairs, it is quite plain to any one who is willing to look conditions squarely in the face that all these western cities have been over-built—some of them are at least two years ahead of requirements. There is an unusual amount of vacant property—offices, stores, and dwellings—and consequently the revenues from building investments are greatly decreased. Of course, ours is a new country, and a year or two cannot fail to see conditions normal again. But why advocate the "Build-Now" policy when such a line of action can only make matters worse? The only sane reason for advocating the "Build-Now" idea is the necessity of providing work for the unemployed—and this is a matter for the Government, not for the investor.

What might be done to help present conditions is to put in hand the many public works necessary to the development of the country. Many public buildings are needed; and there is the construction of a public highway from the Atlantic to the Pacific, besides many other works of a public nature. Pressure should be brought on the Governments so that the authorities might take the lead in this important matter.

Owing to local causes and the absence of manufacturing industries, the western provinces cannot take advantage of any of the activities arising out of the war. The West, then, must look to the Government.

Yours truly,
JAMES McDIARMID.

A test of the efficiency of bituminous carpets for concrete roads was one of the purposes of the Byberry and Bensalem Service Test Road constructed by the Philadelphia Department of Highways. The results of about two years' service on ten areas of this carpeted concrete are recorded in the annual report of the department for 1914. As summarized by Engineering and Contracting, the bituminous covering on five of these areas has practically disappeared; on two it is in fair condition, and on three it is in good condition. No definite analysis in detail is practicable from the published records; but it is plain that all carpetings are not a success, nor are all carpetings a failure. This is information of at least corrective value. There has been observable a rather strong tendency of road engineers to group themselves into two parties, one seeing no value in bituminous carpets and one advocating their use always. Obviously from the Philadelphia tests the value of carpeting a concrete road depends upon the carpet. The immediate duty of road builders then is to determine as far as may be practicable the kinds of bituminous surfacings that are most effective and the degree of their efficiency. Until these facts are available it is hardly logical to assume a partisan stand either of approval or of disapproval.

Hypochlorite in the Milwaukee water supply causes trouble from tastes and odors when applied in sufficient quantity to eliminate gas-forming bacteria and when the temperature falls below 38 deg. Fahr. In his annual report H. P. Bohmann, Superintendent of Waterworks, states that in spite of reducing the rate to 2.3 lb. per million gallons, trouble occurred. The average efficiency of the chemical in eliminating bacteria was 96.56 per cent. B. coli were present in the raw water on 189 days in 1 cu. cm. and on 270 days in 10 cu. cm. In the treated water the corresponding figures are 3 days in 1 cu. cm. and 48 days in 10 cu. cm. The average number of bacteria per cubic centimeter on gelatine in the treated water was 94, with a maximum of 2,000 and minimum of 0. Corresponding figures for the raw water are 2,590, 14,200 and 80.

Water consumed in Milwaukee per capita during 1914 averaged 110.2 gals., a reduction of 1.3 gals. over the previous year. Because of the large number of manufacturing establishments it is practically impossible, according to the last annual report of the waterworks department, to expect a much lower consumption.

Cutting Costs on Road Work by the Use of Industrial Equipment

IN the Illinois Highway Bulletin for April, Mr. F. Tarrant, Division Engineer of the Illinois Highway Department, describes how the Department have operated industrial railway equipment on the highway work of the State. In building country roads they have made the maximum possible use of this equipment, but by the method of using they have kept down the cost to the lowest possible point. The equipment used in the construction of a 12.5-mile water-bound macadam road 10 ft. wide consisted of two 20 h.p. locomotives, 6 miles of portable track and sixty cars. The rails and ties were made up into 15-ft. sections, each section weighing 225 lbs., and capable of being handled by two men. The switch and curved sections were in 15-ft. lengths also, and were easily and quickly fitted into the main track in case a switch or turnout was desired. The steel ties and angle joints were all bolted securely.

Two flat cars were received for use in hauling steel, but Mr. Tarrant found that better results could be obtained by removing the beds from the stone cars and hanging sixteen or eighteen sections on each truck, coupling them together by a 6-ft. pole. Later, when the entire equipment was moved overland to another job, it was a common occurrence to see one of the engines pushing or pulling fifteen of these trucks.

Track Laying

A crew of four men was found to work to the best advantage. The amount of track this crew could lay depended largely upon natural conditions. After becoming thoroughly acquainted with the work and knowing how to take advantage of it, an average of 2,000 ft. could easily be laid and lined in one day. The track was usually laid the full length of the road and near the side of the prepared sub-grade. The construction of the road was started at the far end, and, as the work was completed, the track was pulled up and relaid on the next route, or brought into the yard and stacked in a pile ready for shipment.

In order to keep the track in good alignment one man was required to go over it continually looking for low joints and loose connections. This is important in case there are any steep grades, since it is absolutely necessary to keep the track in first-class shape in such places. Care in this matter greatly increases the efficiency of the engine. It was often necessary to increase the speed of the engine in order to climb the grade with the load. The train load was made up by placing ten or twelve loaded cars ahead of the engine and from twelve to sixteen loads behind, depending on the grade. Where grades were 4 per cent. or over, it was necessary for the train crew to drop the rear end of the train, push the cars in front of the engine to the top of the hill, and then back up for the rear end. This required but little extra time and made it possible to haul 30 to 40 cu. yds. a trip.

The cars were 1,000 lbs. steel dump, capable of dumping on either side, and having a capacity of ½ yd. of material. The dumping of the stone was handled by a brakeman and helper. The train was stopped at the proper place and eight to ten cars tipped over, dumping the stone about the centre of the prepared sub-grade. After the stone as dumped, the empties were pulled out and the track thrown over on the earth shoulder and realigned. By uniform loading the proper amount of stone was dumped from each car to make the desired thickness of stone in the road.

To increase the length of time that the engine might be out on the line a mule was used for yard switching. The watering plant consisted of a gasoline engine and an elevated tank with coal bins handy, so that coal and water could be taken at the same time, thus minimizing any delay to the engine. A small amount of time wasted on each trip due to poor organization and switching in the yard with the engine soon mounts up, and in the course of a day one or more trips may be lost which would add greatly to the cost of hauling.

Transfer Equipment Overland

Upon the completion of hauling stone for 8.5 miles of the road, the central loading station together with the entire equipment was transferred 6 miles overland to a new station. This was accomplished in six days by picking up the track in the rear and hauling and placing it ahead continuously. In this manner the entire equipment was moved quicker and cheaper than if it had all been picked up and loaded on railroad cars. The movement, including picking up and relaying track to the new location, cost $329.

Weather and Soil No Handicap

Weather conditions had little effect on the hauling, as only two days in the entire season were lost, and that was due to the fact that ¼ mile of the track was laid on low ground and the water was above the rails. The soil was of a heavy black mucky nature and one in which hauling by means of teams or tractors would have been greatly handicapped in wet weather. The only way in which it affected the industrial railway was to make the shifting of the track more difficult than in dry weather.

The equipment was leased for six months. A little less than five months' time was consumed in hauling 25,473 cu. yds. of stone with an average haul of 3.17 miles, which included unloading and reloading of equipment. The cost of hauling the stone on the rental basis, which included all expenses incurred in the hauling as well as freight both ways from Koppel, Pa., was 14.8 cents per ton-mile. The comparative cost of team haul on this particular job was estimated to be 28 to 30 cents per ton-mile, regardless of the fact that it would have been impossible to have secured a sufficient number of teams to have completed the work in a year. In this instance if the township had owned the equipment the cost per ton-mile would have been still lower. Assuming 20 per cent. for depreciation, also the necessary repairs to put the equipment in good working condition after use, the cost would have been 11 cents per ton-mile.

In conclusion, Mr. Tarrant states that some of the advantages to be derived from the use of industrial equipment are: Low cost of hauling; quicker hauling;

independence of weather conditions; freedom from labor strikes; reduction of number of men on the pay roll; no expense for resurfacing sub-grade; minimizing danger in passing over country bridges, due to light weight of equipment; and smallness of space required for operation.

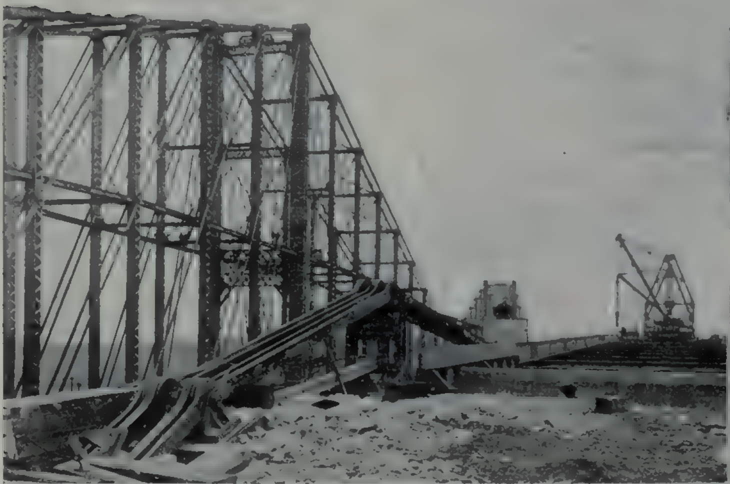
Highway Arch Bridge at St. John, N.B.

RANKING among the heaviest and shallowest structures of this type, the new highway arch bridge over the gorge of the St. John River was designed to carry city traffic, including a double track street railway. The arch spans the Reversible Falls between the railway cantilever and the old suspension bridge, which it will eventually replace. The floor of the new bridge is of reinforced concrete with a creosoted wood block surface, and with concrete slabs for the sidewalks. The latter are 7 feet wide and are partially cantilevered on brackets from the top chord. Between curbs the roadway measures 36 feet, the trolley poles for the electric railway being placed on the centre line while the lamp posts are incorporated in the railings at either side.

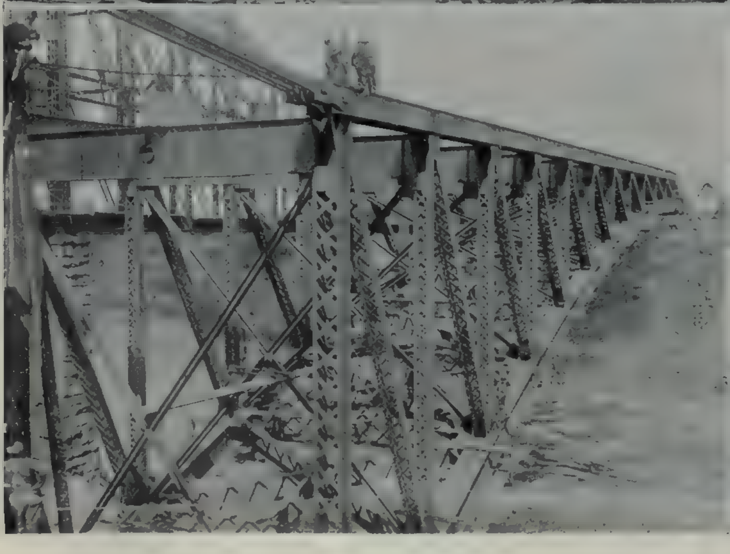
River traffic being considerable at slack tides, clearance was demanded as nearly as possible equal to that previously existing, consistent with good design and pleasing appearance; and this feature led to the adoption of the flat parabolic spandrel braced arch. The distance between centres of skew back pins is 565 feet, the height between skew back pins and the centre pin in the bottom chord being 61 feet 3 inches. The depth of the trusses is 60 feet at the end posts and 8 feet 6 inches at the centre, and they are spaced 41 feet apart centre to centre.

At each end of the arch there is an approach span of plate girder construction, equal in length to two panels of the main bridge, the total length between abutments thus being 654 feet. The steel in the structure, including railings and skew back castings, amounts to 2,181 tons.

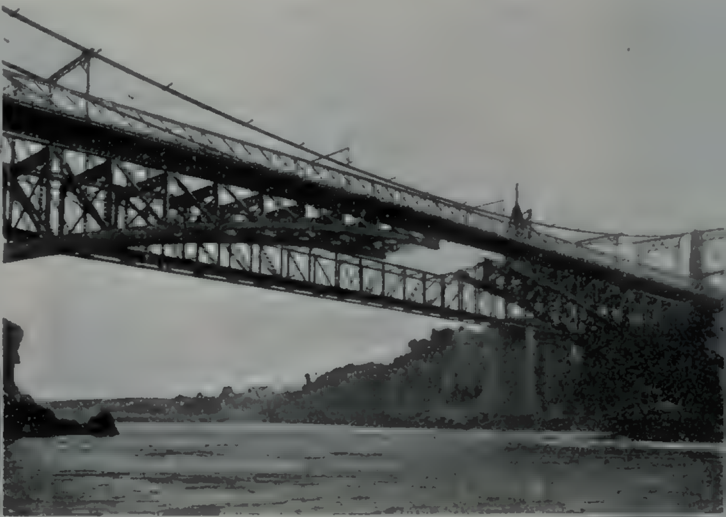
The span was erected as a cantilever from both ends, and upon the junction being made at the centre, the condition of a three-hinged arch was secured. By the insertion of the centre portion of top chord, accurately fitted and under no stress, all further dead load, such as flooring and minor steel work, as well as live



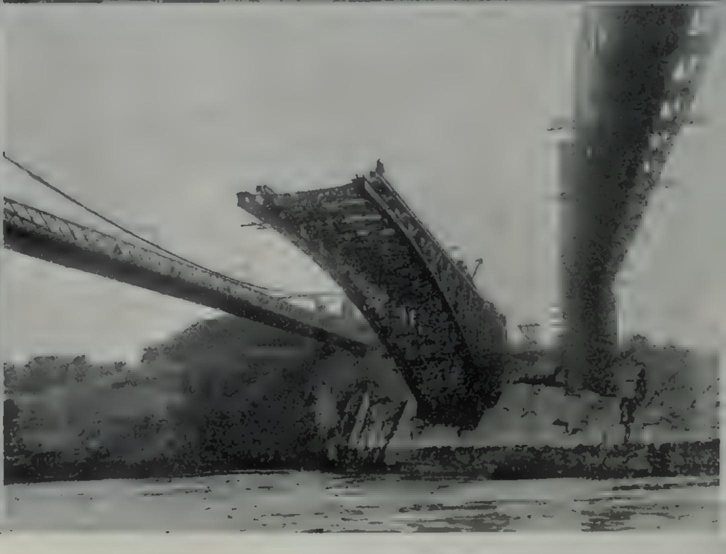
West end anchor bars.



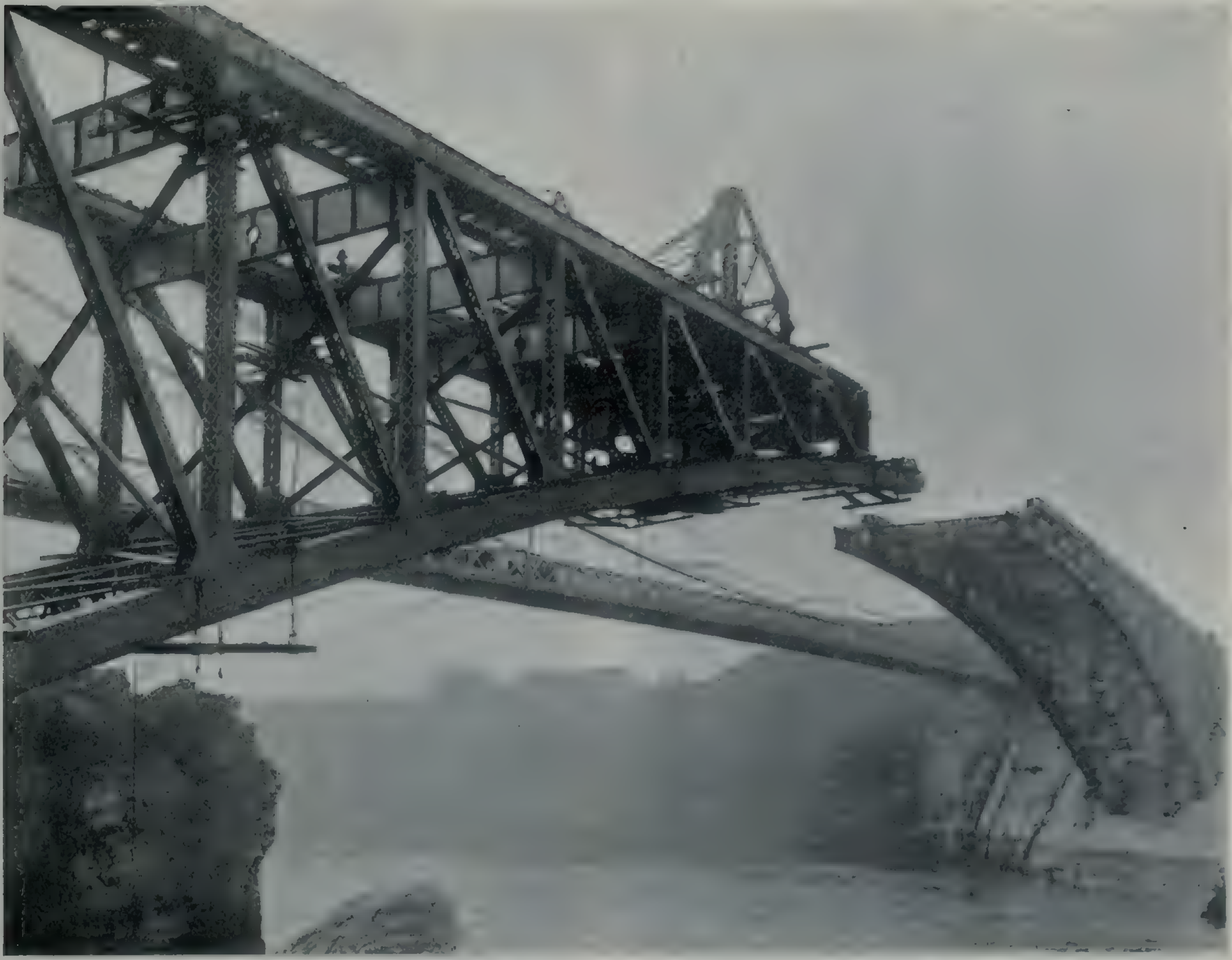
West end cantilevered.



Erection of the east arm.



West arm from east bank.



Progress view of the construction of the St. John arch.

load, was carried by the truss as a two-hinged arch. The anchorage during erection was accomplished by connecting a chain of eye-bar members to the upper chord and guiding them by inclined shoes at pin points into anchor pits. The pits were excavated to a sufficient depth to secure ample reaction against uplift, chambers were hollowed out at the bottom, and crossbeams and girders served to engage the concrete with which the pits were then filled. By this means the weight and strength of the natural rock were used as anchorage factors, the total uplift in each pit being calculated at about 1,075 tons. Adjustment of the position of the cantilevered truss was made possible by the provision of a toggle arrangement, consisting simply of powerful hydraulic jacks, reaching against the abutment, and capable of lifting that pin point in each eyebar chain which was situated some fifty feet from the arch end post. Two 190-ton jacks for each truss were sufficient for all purposes, including the final adjustments necessary for the insertion of centre pin and centre top chord.

The photographs illustrate the erection progress as carried out last fall and serve also to indicate the character of the site. The uniqueness of the situation is realized when a suspension, a cantilever and an arch bridge are seen side by side.

The new span was built for the Province of New Brunswick, the general design being prepared by Mr. C. C. Schneider, of Philadelphia. The Dominion Bridge Company, of Montreal, were the contractors for the supply and erection of steel work, concrete flooring and the wood block pavement.

Storage of Cement

Many dealers who have made a success in the handling of cement insist upon laying a double floor in their warehouse, with a layer of building paper between. This insures beyond all doubt that no dampness will penetrate and be absorbed by the cement resting directly upon the floor. The same result is secured by laying blocks on the floor, and placing boards over them, thus providing a platform slightly raised above the storeroom floor. In any case it is well to cover the pile of bags with canvas or with building paper.

It goes without saying, of course, that any building in which cement is stored should be weather-proof, and should have its floor tight and not resting directly on the ground, and the floor should be provided with means for ventilation. It is advisable also to see that the cement is not stored in such a position that it will be exposed to draughts of damp, moisture-laden air from doors or other openings in the storage warehouse.

Cement, properly stored, can be carried from one season to another without deterioration. Long storage, however, tends to retard its setting, though not preventing its ultimate acquisition of full hardness and strength.

Construction Features of Power Development Work at Eugenia Falls, Ont.

RATHER more than a year and a half ago the Hydro-Electric Power Commission of Ontario obtained authority to proceed with the development of power at Eugenia Falls for the supply of the Owen Sound district. Plans and specifications were prepared, and tenders for the dams, canal, and flume line excavation and head works were taken in May, 1914. The contract for No. 1 dam was awarded to the Ambursen Hydraulic Construction Company, Montreal, and for No. 2 dam, as well as for the canal, flume line excavation and head works, the contract was awarded to the Hyland Construction Company, Toronto.

Toronto.

Portion of cut-off trench in No. 1 dam cleaned off ready for placing concrete.

Power house location and penstock line.

The Eugenia Falls Development is noteworthy as being the highest head in Canada east of the Rockies—530 feet. The ultimate capacity will be about 8,000 h.p., in four units, of which two only are being installed at present.

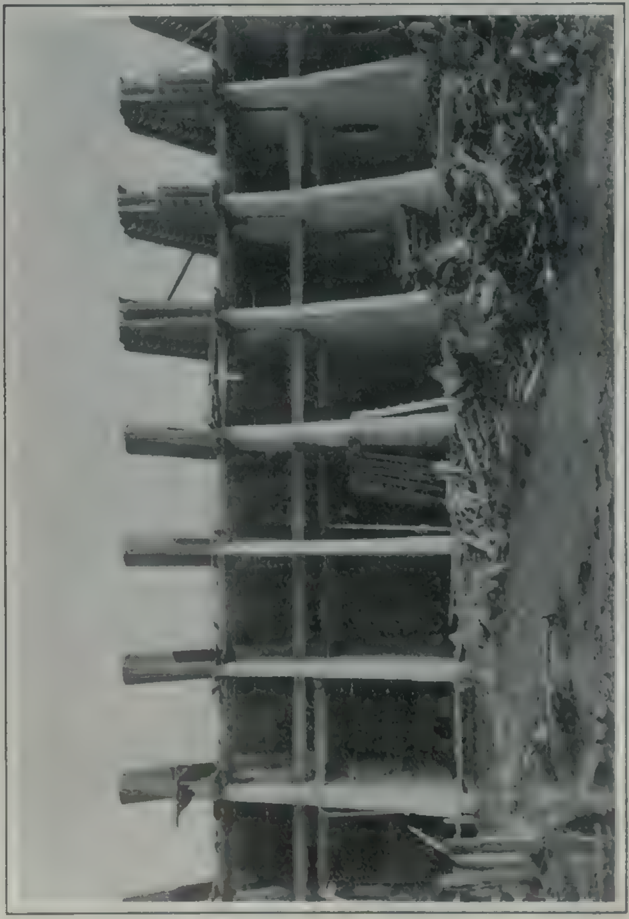
The general layout of the Eugenia Falls power development is shown in the accompanying illustrations. It consists essentially of a storage basin, about 1,650 acres in area, created by two dams. No. 1 Dam, located in the main channel of the stream, is of reinforced concrete construction, and No. 2 Dam, which closes a low contour in the side of the storage basin, is of earth fill construction, with a clay puddle core and rip-rapped faces. The canal leading from the main storage basin is designed to carry the maximum volume of water required for a peak capacity of 8,000 h.p. at minimum draft level. The gate house consists of reinforced concrete wing walls with mass concrete inlet piers having reinforced concrete curtain walls between them. In each of the two inlet openings is placed a 66-in. butterfly valve provided with a combined motor-operated and hand-operated mechanism. The water leaves the gate house through two 46-in. wood stave pipes, 3,350 feet long, operating under a maximum head of about 100 feet. The wood stave pipes are connected at the head block to two 52-in. riveted steel penstocks, 1,557 feet long, operating under an average static head of 530 feet. A cross-over connection to be controlled by a 36-in. valve is provided at the power-house end. The present installation consists of one wood pipe and one penstock, this being sufficient for the handling of the preliminary installed capacity of 4,000 e.h.p. At the junction of the wood stave pipe and the steel penstock, a differential surge tank is provided, and at the power-house end of the penstock is located a 50-in. butterfly valve operated by a hydraulic impulse motor.

In the power-house substructure is to be installed a cast steel distributor pipe, with connections for two 2,250 h.p. turbines. These turbines are of the reaction

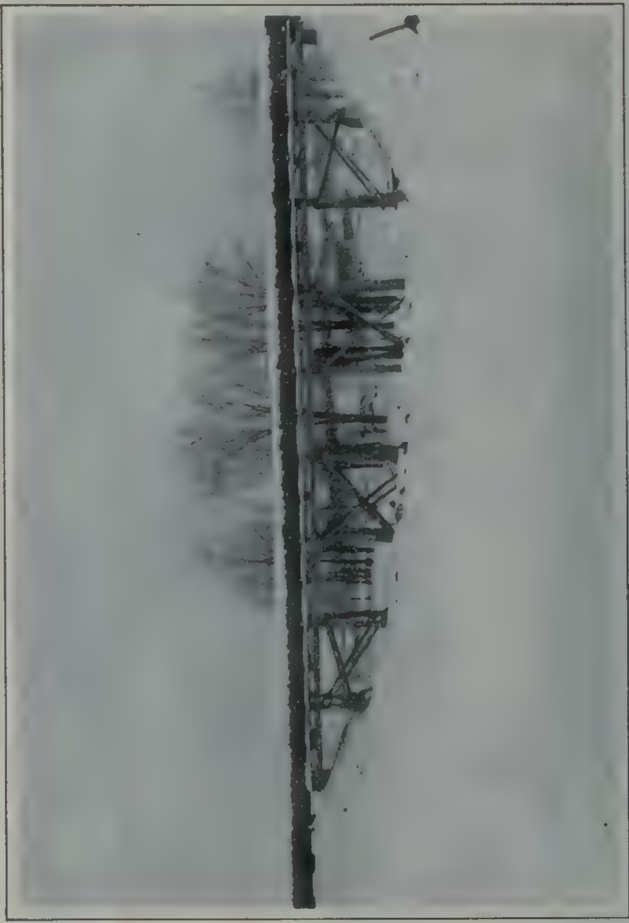
South half of No. 1 dam.

North half of No. 1 dam.

Line of partially completed buttresses.



Buttresses of No. 1 dam in course of construction.



Wood-stave pipe-line carried across a depression. Trestle built of cedar cut from the reservoir basin.

Lower end of canal, and gate-house substructure.

Up-stream face of No. 2 dam, showing unfinished rip-rap.

No. 2 dam in early stages of construction.

type with spiral wheel-cases and overhung runners. They will operate at 900 revolutions a minute, and are equipped with 6,000-lb. flywheels and automatic by-pass relief valves direct connected to the governor.

Both contractors displayed great energy in starting and carrying on the work, with the result that the Hyland Construction Company finished all the work required of them within the time limit, and the Ambursen Hydraulic Construction Company not only fully met their contract obligations, but had so far completed the entire work on the contract that they were able to dismantle and partially remove their construction plant before Christmas.

Additional contracts for this work were awarded as follows: Wood stave pipe, Pacific Coast Pipe Company, Vancouver, B.C.; surge tank, Canadian Allis-Chalmers Company, Toronto; steel penstock, Thor Iron Works, Toronto; turbines, Escher Wyss & Company, Zurich, Switzerland; electrical equipment, Canadian Westinghouse Company.

Irrigation and Power Canal Design

By C. A. Farwell[*]

DURING the winter of 1912-13 the writer visited a number of irrigation and power projects in the West, to study costs and determine the best practice in the design and construction of concrete linings for large canals. The investigation included the alignment, grades and cross-sections of the canals. Data were obtained partly by observation and partly from the engineers associated with the work. The information was transmitted in the form of a report to the Pearson Engineering Corporation, New York City, for use in the design and construction of the canals of the Riegos y Fuerza del Ebro, S. A., Barcelona, Spain. Some of the points brought out are given by The Engineering Record.

Design

It is assumed that the capacity of the canal to be designed is fixed by outside considerations, either the available supply or the amount needed for the project. On irrigation work the main canal is designed for a constant flow over a period of several months of the year, while on power development there are hourly fluctuations, depending directly on the power loads. In this latter case it is of course necessary to make the canal of sufficient capacity to handle the "peak" loads. If at all possible it is customary to provide storage reservoirs above, and sometimes below, the power houses, to take care of these hourly fluctuations, as was done on the Los Angeles Aqueduct, where the conduit has a capacity, in general, of 430 sec.-ft., while the section which includes the power drops has a capacity of 1,000 sec.-ft. between two reservoirs. The shorter ths secton can be made the better.

In designing the cross-section of the canal, there are two general classes, into one of which the canal under consideration may be placed: (a) Where the grade is fixed by the topography or by elevatons of the intake and outlet, and (b) where the canal grade is not fixed, but is dependent on the relation between costs of construction and value of head.

(A) Where the Grade is Fixed

The fixing of the grade determines, within close limits, the velocity of the water in the canal and the area of the cross-section. The grade may be such that the velocity will be low enough to permit the use of an unlined canal, but even if this is the case, it is possible that lining will increase the capacity or cut down the excavation and seepage to an extent that will more than pay for the extra cost. In general, the points to be considered are as follows:

(1) General Shape of the Section.—The trapezoidal section is by far the most generally used, and any disadvantages that it may have are usually considered to be of no importance. It is claimed by some engineers that a small curve in the corners is an improvement, but this is doubtful. If the lining is not built in place, the semi-circular section is probably the most economical. Where there is any possibility of upward pressure on the bottom the curved bottom is an improvement, as it is very little, if any, more expensive than the flat bottom.

The relation of the bottom width to the depth is dependent largely on the cross slope of the country through which the location passes, but there is a certain proper hydraulic relation that should be considered. It can be shown by computation that there is a certain relation between the bottom width and the depth that gives a maximum hydraulic radius and a resulting maximum capacity for any given canal grade.

Theoretical computations, with assumed conditions closely approximating those actually encountered, will determine the most economical shape of section to use.

(2) Location with Relation to Natural Ground Surface.—In country where the cost is not excessive, it is considered good practice to locate the canal entirely in "thorough cut" if concrete lining is to be used. It seems to be practically impossible so to compact a fill that there will not be settlement, with its resulting displacement of the lining. Judgment must of course be used in determining to what extent the location shall follow the contour, as it is impossible to do away entirely with small fills in rough country.

It is noticeable that where canals have been built for some time and run into fills for short stretches there is almost invariably a large crack at, or near, the place where the canal passes from cut to fill or vice versa. Attempts are made to care for this, in more modern construction, by reinforcing the lining across the fill section, and this seems to be good design. Where it is necessary for a part of any section to be against other than natural material, as may happen on a very steep side hill, it appears to be good practice to lay up a rubble wall, either dry or with mortar, as a backing for the concrete. Otherwise the sides may be reinforced or buttressed at intervals, but where labor is cheap this latter type of construction would probably be the more expensive.

Freeboard

The amount of freeboard used is largely a matter of judgment, but this judgment shoud be based on several things, viz., the wave action, dependent on the velocities of the water in the canal, and of the wind;

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[*] Of the firm of Fay, Spofford & Thorndike, Boston.

the unknown action of the water surface on sharp curves and at changes of section; the desirable or possible "over-capacity" of the canal, and the damage that would result from an overtopping of the edge by the water. It might be advisable to build the lining only one-half or one-fourth of the distance from the theoretical water surface to the top of the bank, allowing the backfilled bank to supplement the concrete freeboard in extreme cases.

In regard to alignment, there seems to be no objection to curves down to 150 ft. radius or less, provided the velocity is not excessive.

It is doubtful, at least in the writer's opinion, if anything is gained, except possibly in appearance, by a too close adherence to the standard section or located line. After the excavation is made the lining should be placed on the side slopes as they lie. The bottom, of course, should be kept carefully to grade. For instance, if the excavation leaves the bottom a foot too wide in places, nothing would be gained by backfilling to the standard width. In the same way, if the alignment is off a few feet in places, no material harm is done. An extremely accurate alignment results only in a "nice looking" job, at considerable extra expense.

(3) Slope and Thickness of Side Lining.—This is almost entirely dependent on the nature of the material encountered. In a rock cut a thin lining (say 2-in. minimum) on a ½:1 slope is good practice; in a pervious soil, where there would be no danger of pressure behind the concrete, a thin lining on 1:1 or 1½:1 side slopes might be used. Other thicknesses would be used in other kinds of ground, and the question of just the proper thickness is dependent on local conditions. The slope can usually be safely made the stable slope of the material back of the concrete. Where there is danger of water pressure or of the action of frost behind the lining, this must be considered, and in some cases "weepers" may be put in at interals to prevent such pressure, these "weepers" to discharge into the canal or outside, as thought best.

(4) Expansion Joints.—If considered necessary, on account of a very porous backing, special joints may be used; but, as a rule, the cracks between the different panels of the lining, as built, serve all purpoess. Expansion of the concrete when thoroughly saturated with water tends to close all these temporary "contracting" cracks If found advisable, any cracks may be filled, after a season's operation, with cement grout or asphalt.

(5) Surface of the Concrete.—Where forms are used very little can be done to reduce the coefficient of friction after the removal of the forms. If the forms are carefully made, and maintained, of smooth lagging, and the concrete is well spaded, a dense, smooth surface is obtained that can hardly be improved. In order to fill any small air or water voids, it may be well to "wash" this surface with a thin grout, but even this is doubtful. The coefficient (n) in Kutter's formula for such a surface is about 0.013, and if clean metal forms are used may be as low as 0.012, but in the writer's opinion conservative practice would not permit of the use of a lower figure in the computations for the design.

Surfacing the Concrete Where Forms Are Not Used

Where forms are not used, the best practice seems to be to go over the surface with a lean mixture of sand and cement as soon as possible after placing the concrete. It is much better to do this within an hour or two than to allow a day or several days to pass before the plaster is put on. In the covered sections of the Los Angeles Aqueduct the concrete was very damp when the forms were removed, and remained that way for several days; hence the plastering could be delayed with less liability of inferior work.

Care must be taken in plastering, or the surface will "shell off" in time; some engineers are of the opinion that it is almost never entirely reliable. It would seem that the proper value for (n) is between 0.011 and 0.015, depending on the care used, with 0.013 for an average.

Considering the fact that a smooth and impervious concrete lining can only be obtained without forms by the use of a plaster coat, and this of questionable reliability, it seems better to use forms where at all possible.

(6) Reinforcing.—It is probably unnecessary to use reinforcing where the lining is laid on undisturbed or well settled material, unless such material is very porous and seepage dangerous, and even in such cases it seems better to lay the concrete without reinforcing in panels with special, watertight expansion joints. When lining is placed over fills it is good practice to reinforce.

(B) Where the Grade Is Not Fixed

Where the grade is not fixed a seventh factor, the value of head, must be taken into consideration. Between the cheapest possible development of the project and the most expensive there is a design that will give the largest return on the money invested. The grade of the canal is one of the important factors, and the relation between the cost of construction, which varies inversely with the grade (the steeper the grade the less the cost), and the value of head will determine the proper grade to use.

Methods of Construction

Two methods of preparing the surface for concreting have been generally used. In one, all overbreakage is filled with rubble, this method being necessarily confined to location wholly or partly in rock. In the other method the overbreakage is filled with tamped or puddled earth. The puddling may be done in two ways, either by the use of forms of the dimensions of the outside of the proposed concrete, or by the use of guides, where the material is tamped up to the proper line. The use of forms or guides is largely determined by the proposed use or absence of forms for the concrete, forms being used for the backfilling if forms are to be used for the concrete.

The sides are almost invariably concreted first. Where the slopes are ½:1 or steeper, forms are always used; where they are 1½:1 or flatter, no forms are used; but on the 1:1 slopes, both methods are in common use and engineers differ as to which method gives the better results at the lesser cost. The difference in opinion probably arises from the different systems used. It is the experience of the writer and others that if the lagging of the forms is carried up only a little ahead of the concrete no trouble is found in placing concrete behind forms on a 1:1 slope, or even on one considerably flatter.

Where forms are used the concrete is usually placed continuously in lengths of from 12 to 15 ft., with transverse joints between the panels. As soon as possible after the removal of the forms the surface is washed with a grout.

Where forms are not used the surface to be concreted is divided by guides into panels from 12 to 16 ft.

square, and alternate panels are placed. The guides are then removed and the remaining panels are concreted. Except in a few cases, no attempts have been made to provide expansion joints other than the planes of weakness occurring between panels put in at different times. These joints have in some cases been grouted and in others filled with hot asphalt. A "dry" concrete is necessarily used where there are no forms. A plaster coat is usually put on the surface after concreting, either immediately or within a few days, care being taken to keep the concrete damp in the meantime.

The mixer is ordinarily set on the bank and discharged into cars or carts running on or above the canal bottom, and from there is shovelled upon the slope or into the forms. As much spading as desired can be done back of forms, but concrete placed on slopes without forms can be "worked" only a little, with a resulting lack of density.

Costs

The costs obtained were not entirely reliable, as in many cases no accurate figures were available The minimum figure was 3¾ cents per square foot, for several miles of lining ¾-in. thick, laid under almost ideal conditions; the maximum was 25.7 cents per square foot, for a short piece of lining laid 8 ins. thick on the slopes and 6 ins. thick in the bottom. Practically all costs were between 2½ and 4 cents, with an average of a little more than 3 cents per square foot per inch of thickness.

Application is being made for the incorporation of the Export Association of Canada, Limited, whose head office will be at Montreal, and whose capital will be $500,000. The object of the new concern is to secure for Canada a larger portion of the world's trade under the changing conditions brought about by the war, and to develop and carry on the export trade in Canadian products upon lines of national co-operation. The Dominion Government, large railway companies, and manufacturing interests have promised their assistance. The Provisional Directors include Mr. G. H. Duggan, of the Dominion Bridge Company, Limited, Montreal; Mr. H. L. Frost, of the Frost Wire Fence Company, Limited, Hamilton; Mr. R. H. McMaster, of the Steel Company of Canada, Limited, Montreal; and Mr. W. W. Near, of the Page-Hersey Iron, Tube and Lead Company, Limited, Toronto.

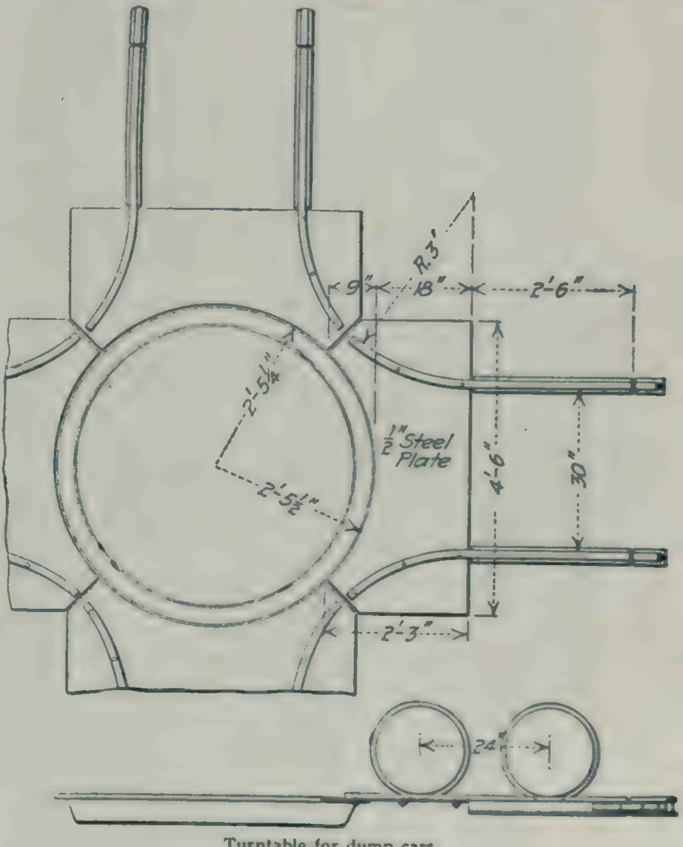
The U. S. Bureau of Standards has evolved a remarkable device for accurately indicating very small deflections of a steel bar 3 ft. long and 3½ ins. in diameter. This bar is supported at each end and a small mirror is fixed at the centre, above which is a frame bearing another partially silvered mirror, both of which reflect the light of a sodium burner, the lower mirror showing a series of black and yellow concentric rings. The slightest pressure on the bar—even the weight of a visiting card or a pin—causes these circlse to expand outward, forming as it were a series of ripples like those made when a stone is dropped into the centre of a still pond. The pressure of one finger on the bar causes the formation of five or six new circles, showing that the bar has been bent about 1/20,000 in., as each new circle means a 1/100,000-in. movement.

In Vancouver, B.C., there are 350 jitney buses operating on the city streets and suburban lines. In Winnipeg there are 572.

Improved Turntable for Contractors' Dump Cars

THE mucking tracks at the Bayonne shaft of the Newark Bay siphon tunnel for the Passaic Valley Sewer include several turntables, on account of the special track arrangement rendered necessary by certain shaft conditions. In the ordinary operation of turntables on industrial tracks the difficulty and loss of time in matching the tracks on the turntable with the fixed tracks are apt to cause frequent derailment, which means serious delay to the whole work. Great simplification of work at the turntable is secured on this job by a novel arrangement of the turntable approach tracks devised by R. H. Keays, Engineer for the contractors, the New York & New Jersey Construction Company, and described by the Engineering News.

The turntable approach, shown in the drawings with this article, has curved diverging track-ends at the approach, with a steel-plate apron between and around them. This apron is a trifle above the normal level of the wheel flanges, so that as the wheels mount the plate they ride on their flanges and become free from top of rail, running forward on the plate to the turntable. Coming off the turntable, the car will run on the plate into the flaring opening of the rail ends, and when the forward wheels come in contact with either rail the car is securely guided on to the track.



Turntable for dump cars.

The plate is fastened to the rail by countersunk bolts through the rail-head, the web and base of rail being cut away.

W. Steenburgh, shaft superintendent for the contractor, says that there have been no derailments at turntables and practically none on the entire trackage in the tunnel. The latter is credited to the care observed in keeping the tracks in good line and surface, which was thought necessary in order to have the electric storage-battery locomotives operate well.

Reinforced Concrete Construction*

Its Advantages and Disadvantages: A Candid Survey of the Structural Functions and Limitations of this Modern Building Material

By Percy J. Waldram

CONCRETE is a material which has received, during the last few years, a considerable amount of very skilful and successful advertising. The effect of this has been enhanced by the intricate nature of the mathematics and formulae by means of which it is commonly supposed to be calculated; and it is popularly regarded as a mysterious and wonderful material which is superior to the natural laws of structural mechanics—enormously strong, extremely cheap, and eminently suitable to almost every possible form of construction from a factory to a stationary cabinet. It is, in fact, far too frequently credited with the almost miraculous powers with which electricity was popularly invested some years ago before its physical and economic limitations became generally known. In many ways, electricity has exceeded the expectations which were formed of it, but we still use a little coal and oil for various purposes. Reinforced concrete has possibly similar unexpected triumphs awaiting it; but steel, wood, brick and stone are by no means obsolete yet. It would appear to be essentially the province of surveyors to form a fair and business-like estimation of its general physical character and of the conditions essential to its proper production; and when these are clearly grasped, the problem resolves itself into a matter of ordinary valuation.

The general physical properties of the material are fairly summed up in its title. It is concrete reinforced. The steel bones and tendons which we supply to the concrete flesh enable it to overcome that want of tensile strength which previously restricted its use to situations in which it could act in compression only—as in arches, arching floors, walls, footings, etc. But the presence of reinforcement does not make any very great difference to the nature of the concrete itself. The latter still remains an active partner in the firm, and the steel must work with it or dissolve partnership; and unless the steel reinforcement is made capable of carrying on the whole of the work, with the concrete acting merely as fireproofing material, dissolution of partnership means ruin.

Hence, even in beams which are reinforced in compression, we are constantly hampered in design by the capabilities of the concrete, which unfortunately are not very high; and in spite of all the important structural advantages resulting from a monolithic form of construction in which the strength of each part of a structure enhances that of its neighbors, reinforced concrete is necessarily heavy and weak for its size as compared with steel or wood. This disadvantage is partially balanced by its almost perfect durability, which enables us to utilize a greater proportion of its ultimate strength than is the case with more perishable materials. But in all cases where severe stresses and the dead weight of long spans are involved, it is useless to expect from it the same strength that we obtain from wood or steel of the same cost.

There are, however, situations where it would, for other reasons, pay to use the weaker material. When properly designed and properly made in situations where it is suitable, it is rot-proof, vermin-proof, fire-resisting, almost waterproof, and grows stronger with age instead of decaying. It can also be readily molded to any given form; and in entire structures, it is wonderfully monolithic, a very considerable advantage in bad foundations. But, at the same time, it is not a material to be used without accurate knowledge of its limitations. It must be designed with skill, made with more than customary care, carefully nursed during its infancy, and protected during the whole of its lifetime from agencies which are deleterious to cement, such as impermeating oils and acids. In some cases these disadvantages are immaterial, and it is the peculiar province of the surveyor to estimate them. In all situations where plain concrete, brickwork, or masonry would customarily be employed, it can be expected to do the same work with far less bulk of material. But, on the other hand, its use invariably entails extra expenditure in casing, which may or may not outweigh the saving of material. A retaining wall, for instance, in reinforced concrete, will do the same work as a solid brick or concrete gravity wall, at a fraction of the cost; but in ordinary dwelling-house solid walls, where there is not much thickness which can properly be saved, reinforced concrete and its casing must be expected to prove more expensive than brick or stone.

On account of the great difference between the stiffness of steel and concrete, as well as between their respective strength, it is a matter of no small mathematical difficulty to devise formulae which will tell us accurately how such an ill-matchel team are going to pull together upon any given load, and what work we can safely entrust to them without running the risk of the too willing steel being overworked, or setting a pace which the concrete cannot keep up with. Even at the present time, after engineering scientists all over the world have been engaged for years upon the subject, there are still problems which no textbooks meet. Many minds are, however, at work, endeavoring on the one hand to complete and standardize our knowledge, and on the other to simplify the mathematics involved.

Reinforced concrete suffers, and suffers badly, from the incubus of tedious and intricate calculations, and it is pleasing to be able to say that the results given by all formulae can be plotted to curves. When these are drawn to large scale, the slightest inaccuracy in calculating them is seen in some irregularity in the sweep of the curve. When they are used instead of the formulae, the designer's task is reduced to that of selecting values from a set of diagrams, in precisely the same way that he now selects a joist or the properties of a stanchion from a table or rolled sections. In my own office we have almost completely eliminated the necessity for using the long standard formulae, having plotted them all on diagrams. The saving of time and trouble effected by their use is enormous; but what is far more important is the notable gain in accuracy. If a draughtsman has a long and intricate formulae to work to, the chances of error are far greater than if he has merely to take a value from a plotted curve. Another important and unexpected advantage which results from the substitution of curves for tedious mathematics, is the rapidity with which the designer can grasp the possibilities of a problem, can compare reinforced concrete with other materials, and, if it is found suitable, select the particular form in which it will give the results which combine efficiency and economy. In a material which has a high ratio of dead weight to strength, it is frequently possible to secure a proper factor of safety only by eliminating all superfluous bulk. The subject of design in reinforced concrete is being extensively taught in technical institutions, and it is to be hoped that as the supply of skilled designers increases the disadvantage of excessive mathematics will disappear.

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*From a paper read before the Surveyors' Institute, London, Eng.

The necessity for skilled labor in construction is often considered to discount the use of reinforced concrete in remote country districts, where it would never pay to send specialist workmen. I would suggest, however, that it is rather a matter of the skilful supervision of the structural ability which is to be found in country and estate workmen. The more remote a district is from large centres of population, the more multifarious are the demands made upon the intelligence and ability of the local workmen. Opinions probably differ on the point; but personally I have always found country workmen remarkably intelligent, and can see no reason why a good estate mason should not very quickly be taught all that is required to make, or to supervise the making of, good reinforced concrete. If he is given good materials and clear drawings, all that is required is a somewhat unusually rigid attention to comparatively simple rules, which can easily be typed on a page or two of foolscap, or stated in his specifications. Any man who is capable of mixing and making really good concrete, who can read, understand, and carry out drawings intelligently, and who can be trusted loyally to adhere to instructions without varying them according to his own ideas, possesses all the necessary capabilities; but he cannot be expected to turn out good work in a material with regard to which he has no previous knowledge or traditional skill, unless his preliminary instructions are clear, definite, and complete. The necessity for skilled labor in the workman, and highly skilled intelligence in the foreman, is so often advanced as an argument against the execution of work otherwise than by a specialist firm, that I would venture to draw attention to a few practical points upon which this argument is largely based. They are seldom emphasized in textbooks, and, being comparatively immaterial in the making of plain concrete, their vital importance in reinforced work is apt to be overlooked.

Materials.—The stereotyped clause that "all materials should be the best of their respective kinds" is not one to be lightly interpreted. They must be of the very best. If the sand requires washing, it is far better out of the work altogether. Washing often removes those finer particles which are essential to a strong, dense mixture. The aeration of cement should never be necessary. If it is of the proper quality and sufficiently ground, it will have been properly aerated by the manufacturer, in which case further aeration will only tend to render it inert. Even if kept too long in sacks, it will be found to cake. Cement should be slow- or at least medium-setting, and should pass the standard tests. It should be recollected that comprehensive cement testing can be carried out only by an experienced specialist in a properly equipped and properly constructed laboratory. It is generally better to have the guarantee of a first-class manufacturer, supplemented by crushing tests on concrete cubes, than to trust to testing deliveries on the site. Unless the tester is experienced and his testing room is perfect, he must expect erratic results if he attempts anything beyond the simple tests for fineness and setting. The aggregate should consist of large, small, and medium-sized particles, the largest of which will easily pass between the reinforcing bars.

Grading and Proportioning.—The presence of small voids in ordinary concrete may be quite harmless, but in reinforced concrete mixing damp may enter and rust the rods, causing them to swell and burst off the cover. In beams there are high stresses concentrated on very small areas of cross-section, in which the presence of a void may be very serious. Voids may also interfere with the adhesion between metal and reinforcement at a vital point. It is therefore necessary to fix the proportions of the aggregate, sand, and cement, with some care, so that the interstices of the larger materials may be exactly filled by the smaller, and a thoroughly dense mixture secured. The deliveries of aggregate should be tested from time to time; and, if necessary, the proportions should be varied. The amount of smaller material necessary to fill up the voids in larger aggregate, and the proportion of voids in sand which must be filled with cement, can easily be obtained by placing a measured quantity of the larger material in a water-tight vessel, and filling in measured quantities of water until it becomes water-logged. For all practical purposes this can be done as accurately by an intelligent gauger with a pail and a pint pot as by a chemist with accurate measuring instruments and the whole of the metric scale at his disposal. The shrinkage which takes place in the volume of material when wetted, must be remembered when estimating the volume necessary to fill the interstices of material of larger size. Ballast aggregate should never be assumed to possess the correct amount of sand. The latter should be screened out, and the correct proportion added back.

Steel.—There are on the market many types of patent reinforcement and varieties of hard-carbon steels. The advisability of adopting any of them in a given situation is a complicated question. For ordinary work, ordinary merchant bars of standard steel are difficult to beat.

Bending.—If reinforcements are, as they should be, kept as small as possible, all ordinary bendings can be done on the site by means of bending irons and a few iron pegs fixed into a wooden baulk. The only machine necessary for ordinary work is an efficient pair of shears. Loose scale should be cleaned off with a wire brush, but a slight coating of rust is not disadvantageous.

Casings and Falsework.—These should be made out of stout, well-seasoned wood, put together with a view to solid firmness while the concrete is setting, and afterwards coming away easily without jarring or hammering. Unless concrete is kept absolutely quiet and still until it hardens, the process of setting will be seriously interfered with or arrested altogether. For this reason the ideal connection for casings consists of outside bolts and straps; but the next best method is by square-cut nails with the heads left projecting half an inch, so that they can easily be drawn by the leverage of a claw-hammer or a split crowbar. Screws are apt to rust in badly, however well they may be greased. It generally pays to plane such parts of the casing as come into contact with the concrete, so that it will come away easily, leaving a smooth-finished face. With the same object in view the forms are sometimes oiled. This should be done with care. The oil should be thin and allowed to dry. Most fats and oils are deleterious to cement, but are especially so when the concrete is green.

Mixing and Placing of Concrete.—In all cases where the concrete will be heavily stressed in compression, it pays to use a rich, strong mixture (say 1:1½:3), rather than to make up the deficient strength of a weaker mixture by means of compressive reinforcement, which must always be expensive and uneconomical. When the mixing is done by hand, the sand and cement should be thoroughly mixed first until the color is a uniform grey; then the aggregate should be added and mixed; and finally the water in measured quantity, the whole being then turned over until it is of uniform consistency. Machine mixing should combine a tipping with a rotary motion, unless the rotating drum is provided with inside blades. A very simple and yet very efficient mixer is a large wooden barrel with a hopper door formed in one end. The barrel is filled about half-full or less; the hopper door is closed, and the barrel rolled along to where the concrete is required, the tapered ends giving the necessary combined pitch and roll to the contents. Experience will soon determine how far the barrel requires to be rolled before the contents are ready for the large aggregate and for the water to be added, and the measuring stations for these are arranged accordingly. The forms and centreing should be thoroughly drenched (not merely wetted) before the concrete is filled in.

Nursing of Green Concrete.—It is impossible to over-rate the importance of keeping the concrete thoroughly wet and perfectly still until setting is complete. It should be kept watered and protected from drying winds and sun for the first week or ten days of hardening, and it should be somebody's particular duty to see to this over week-ends and holidays. All sawdust from the making of forms should be carefully preserved for spreading over floors as soon as the surface is hard enough.

Test Cubes.—In all large work, small test cubes of concrete should be made from each batch of concrete, tamped to the same atmospheric conditions, and tested by crushing. Cubes of 4-in. side, or 6-in. cylinders, are usually specified; but it is not easy to construct a machine which will crush these. It is far better to have plenty of 3-in. cubes crushed on the site by a simple lever testing-machine made of 11-in. floor joists, than to send, at considerable expense, one or two 6-in. cubes to be crushed at the nearest town which possesses a 50-ton testing-machine. All the foregoing precautions are comparatively simple. Usually the difficulty is to get workmen to appreciate their importance. It is a good rule to have one person responsible for each particular matter which needs looking after, provided with clear typewritten instructions as to what he has to see to, and a definite penalty awaiting any carelessness. If the work is small, possibly one man can look after everything, in addition, perhaps, to doing part of the work himself; but two men should never share any one responsibility, however insignificant. Sooner or later both will overlook it, and each blame the other. We may, however, conclude that if clear, large-scale drawings in sufficient detail are supplied to the foreman, with carefully drawn-up instructions, there is no need to consider the necessity for skilled labor to be a matter which should weigh unduly against the use of the material.

The chief points in favor of reinforced concrete are:

1. Its freedom from decay and its improvement with age.
2. Its impermeability, which prevents insects and disease germs from harboring in it.
3. Its monolithic character.

Its chief disadvantages are:

1. Its cost.
2. Its weight and bulk for a given degree of strength.
3. The difficulty of making alterations in it, or of strengthening parts which prove to be weak.

When and Where Not to Use Reinforced Concrete.—Upon these general considerations it is possible to form a sound opinion as to whether in any given situation its use would probably prove advantageous or the reverse. It should be expected to show advantages in efficiency or economy, or both, in situations where:

(a) Fire risk is a predominant or an important consideration.

(b) Repairs and renewals are expensive, inconvenient, or difficult; or where neglected or unperceived decay is dangerous, as in sea reclamation works, reservoirs, storage tanks, etc.

(c) Where a hard, impervious surface, which can be readily cleaned, means money in the long run, as in the walls, floors, and fittings of farm buildings, and especially of dairies; in storage tanks, grain stores, silo, etc.

(d) Where it can be substituted for plain concrete, or thick masonry, as in retaining walls, foundations, rain-tanks forming the roofs of dairies, water towers, and above-ground silos.

(e) Where considerable repetition reduces the cost of centreing and falsework, as in piggeries and cow-barns, and their fittings, mangers, troughs, etc.

(f) In large complete buildings of a straightforward character, such as storage warehouses, especially on poor foundations.

It would be handicapped by its weight, bulk, cost, and by its permanent character where:

(a) Long spans or heavy loads are involved.

(b) Where steel or timber can be used for the same purposes without disadvantage.

(c) Where the work is small, and there is little or no repetition to enable casings to be re-used, as in single cottages.

(d) Where the finished details of the work are not or cannot be settled, or where a building is only required for a few years. Cutting or altering a reinforced building, or pulling it down for re-erection elsewhere, are all but impossible.

Recent contracts for shells placed in Canada include one for 1,500,000 shells awarded to the Dominion Steel Corporation at Sydney, N.S., one for 30,000 shells awarded to the Vancouver Engineering Company, Vancouver, B.C., and another for 100,000 shells given to the Loughead Manufacturing Company, of Sarnia, Ont. The Robb Foundry Company, of Amherst, N.S., have installed $30,000 worth of new machinery and will work three eight-hour shifts a day. The Saskatchewan Bridge & Iron Works, Moose Jaw, Sask., who have an order for one million dollars' worth of shells, are having new machinery shipped from the east, and expect to have it running twenty-four hours a day within a fortnight.

Maisonneuve Public Bath

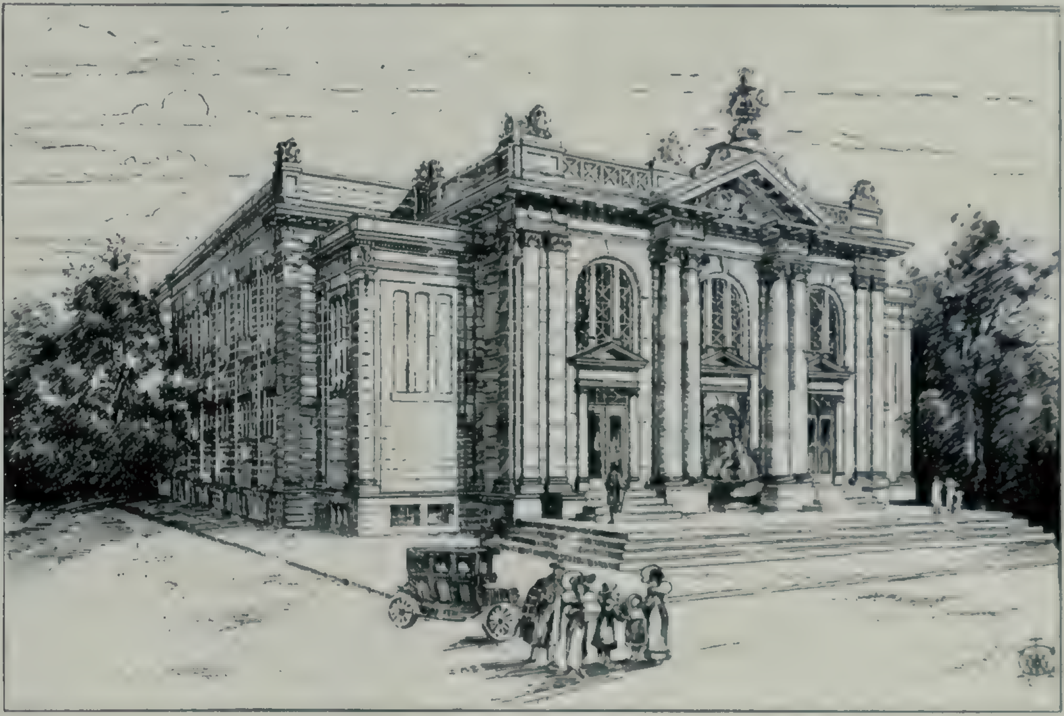
On instructions from the Town Council of Maisonneuve, Que., Mr. Marius Dufresne prepared plans for a public bath and gymnasium, which is now being erected by Mr. Theo. Lessard, Montreal. The site is on Morgan Boulevard, and has a frontage of 93 ft., and a depth of 144 ft. The structure will consist of a basement and two floors. The front portion of the exterior is of Indiana limestone backed with plastic brick, while the side walls are of Greendale Rug brick (supplied by Webster & Sons, Limited, Montreal), with Indiana limestone trimmings around the windows, the cornices being of stone. The base is of Stanstead granite, and the porch and the steps leading up to the two entrances are of the same material. A bronze fountain placed between four columns of Indiana limestone at the entrance was designed specially for the building.

Inside the entrances on the main floor is a caretaker's office, provided with two wickets, where the bathers secure suits and towels. From here run wide passages and walls on either side, separating the pool in the centre from rows of lockers built against the outside walls. Each locker has a shower bath. Entrance is gained from the lockers to the pool by crossing the passage-way and passing through doors in the inner wall on to a tiled walk. At one end of the pool there are private baths. The pool is provided with the usual springboards. Light is secured from a skylight in the roof.

The next floor is reached by two stairways running off from either side of the entrance hall. In effect the floor consists of a large gallery running round three sides of the ground floor, the centre portion being open so as to give light to the pool below. The gymnasium is located on either side of the gallery, the front portion of which is occupied by lockers and a caretaker's office, the latter being reached by a stairway from the caretaker's office on the ground floor. A balustrade is built out from the first floor over the pool.

Water is supplied by the mains of the Montreal Water and Power Company, and comes from an artesian well a short distance away. Water from the well is pumped into a large tank erected 80 ft. high, and flows into the bath by gravity. A power house adjoins the bath at the rear; it is one storey in height, and has two entrances from the street. Communication between the bath and the power house is provided by a door in the basement of the former, this giving access to a stairway leading directly into the basement of the power house. The house is equipped with two 85 horse-power Babcock & Wilcox boilers, with a pump of the Weir type. Steam from the boilers passes through three Presto heaters, by the J. W. Harris Manufacturing Company, Limited, Montreal, the heated water being supplied to the pool and shower baths, and for heating the building. By means of a tunnel, steam is also supplied to the adjoining public market, where it passes through two Presto heaters, thus giving the necessary hot water.

The foundations of the building are of reinforced concrete. The shell is carried on a steel frame, made by the Dominion Bridge Company, the Canadian Seigwart Beam Company, Montreal, having the contract for the supply of their reinforced hollow beams for floors and ceiling. The pool is made of reinforced concrete lined with plastic brick, which is faced with enamelled white brick supplied by Hyde and Sons, Limited, Montreal. The gymnasium floors are of hardwood, the ground floor of terrazzo, and the floors at the entrances are made of tile.


The Maisonneuve Public Bath.

Although the Federal Railway Commission decided to withhold judgment in a recent hearing at Petrolia, Ont., for the purpose of fixing a rate for the hauling of gravel in Western Ontario, it is generally believed that they will fix the rate at one cent per ton-mile. Should this be decided on, many of the western Ontario municipalities will commence the use of gravel dredged from the St. Clair River, which is of the purest quality obtainable, and the results should be reflected in a considerable improvement in the roads of the western end of the province.

Street Cleaning in Calgary*

IMPROVED methods in street cleaning adopted by the street cleaning department of Calgary during the past year have resulted in increased efficiency in the work of the department, and though costs of operation have been reduced somewhat, the streets have been maintained in good condition. The new cost keeping system put in force by Superintendent T. F. Robbins about a year ago is producing excellent results.

The city, despite its population of only about 75,000, covers an area, it is stated, equal to that of Paris. It is divided for street cleaning purposes into two districts, in charge of each of which is a foreman. A third foreman looks after the work in both these districts in the night-time during the summer months, while during the winter he is put in charge of the work of cleaning the 1,200 catch basins, which must be kept open all the time in order to carry away the water from the melting snows.

Each of the regular foremen sub-divides his area into beats of from four to ten blocks and to each of these a street cleaner with a pushcart is assigned. There are at present 80 such men, who receive a wage of 28 cents an hour, seven hours constituting a day. The third foreman, whose gang also cleans the catch-basins, employs for this work six men who are paid on a monthly basis.

The sweepers fill their pushcarts with the sweepings and dump them into waste boxes, which are conveniently placed in alleys centrally located in each beat. These, in turn, are emptied by wagons and by two 5-ton motor trucks which convey the refuse to the dump or the incinerator.

In addition to the sweepers mentioned above, the department has four horse flushers, four rotary brooms, two electrically driven flushers, and five horse-drawn sprinkling tanks. It is especially due to the work of the motor-driven flushers that the streets are kept in such a clean condition, and because of their economy the horse-drawn brooms and sprinkling carts, although fairly satisfactory, will soon be replaced with motor equipment if Superintendent Robbins' plans are carried out.

The electrically driven flushers are each equipped with a tank having a capacity of 1,200 U. S. gallons. Each tank has a total length of 160 inches and an inside diameter of 51 inches and weighs 3,600 pounds. There is an air compartment in the forward end of each tank which is 36 inches long, designed to carry a pressure of 65 pounds. Each tank is provided with air and water pressure gauges and a pop safety valve in a by-pass connecting the water space with the air chamber. The tank is filled by means of a 2½-inch intake in the centre of the rear drumhead. The water discharge is controlled through lever gate valves operated by hand at the driver's seat, and by these levers two flusher nozzles may be worked together or independently. The main outlet connection is a 4½-inch pipe and the flushing nozzle connections are 2½-inch.

The two 5-ton electric trucks which are employed in hauling the street sweepings and refuse to the incinerator or the dump are each fitted with large boxes specially designed by Superintendent Robbins for the purpose. Each box carries approximately three wagon loads of refuse. They may be dumped by the driver from the seat. In addition to these, from 10 to 15 teams are constantly employed. When not needed for street cleaning work, these teams are hired to the public works department. This arrangement between the city departments has worked out very satisfactorily and has proven economical.

With the force and equipment mentioned, 1,356,482 yards of pavement—approximately 64 miles—were cleaned in 1914 at a cost of less than $120,000. This is a reduction of several thousand dollars on the figures for 1913, the saving being effected mostly by means of the modern machinery mentioned and by the efficiency methods introduced by Superintendent Robbins, who was appointed at the beginning of 1914.

During the year the street cleaners gathered and hauled to the various dumps 7,635 loads of street-sweppings. Snow removed from the business section of the city totalled 7,407 loads. For the purpose of filling holes in the pavements and sanding walks and streets when icy, 497 loads of earth, sand and cracked stone were hauled, making a total of 15,539 loads of material handled by the horse teams.

During the same period, the four horse brooms and the four flushers swept 4,576 blocks of pavement and flushed 2,184 of them, while the electric machines washed 5,535 blocks, making a total number of blocks cleaned by machinery of 12,295.

The number of tanks of water used during the year by the horse-drawn machinery for sweeping and flushing was 5,417 and 8,469 were used for sprinkling, making a total of 13,886. The number of tanks of water used by the electric machines was 18,113.

The electric flushers worked two shifts each day during the summer—nine hours of day and eight of night work. Their total mileage for the year was 17,759 miles, an average of 38 miles every day and 17 miles every night. Each truck used an average of $1.30 worth of electric current during the 17 hours. It is estimated that the use of these machines saved the city $24 a day on the cost of watering the streets. This economy was achieved despite very high fixed charges placed against the machines, which made the total expense during the season amount to $8,544.94, which works out at the rate of 48 cents a mile. The fixed charges included a depreciation based on a life of seven years and the total charge placed against them amounted to over $261 per month. It is understood that these figures will be revised for this year and the depreciation charge greatly reduced.

Superintendent Robbins estimated that one of these electrically driven machines does the work of three horse machines Teams are hired at $4.50 a day with the wage of the drivers included, and it will readily be seen that a large saving is effected.

The six men who look after the catch basins, when not so employed are used for other work, as when a heavy snow has fallen or in similar emergencies. Two teams are assigned to this squad in the winter and in the summer there are three, two of the men working in the business districts during the night with the extra team. These men also wash out the subway beneath the railway lines once a week on the average during the summer. Whenever there is a heavy fall of snow all these teams are used, if necessary, to remove it, while in the spring or during thaws in winter (which are fairly numerous) two of the men are assigned to go around with a steam boiler and thaw out the frozen catch basins. All of these men are on the monthly payroll and receive a straight wage of $75 per month.

An expense-saving appliance used by the department is the gutter plow for clearing sidewalks and gutters of snow. This device does the work of several men at a small cost. The plows cost only $20 and six of them are used by the department. With the use of these, the men heap the snow in piles at the street corners, whence it is removed by bob-sleds, the lowness of which greatly facilitates the work of loading.

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*By W. E. Hardenburg in The Municipal Journal.

A factor in the savings that have been effected is the daily report which is made to the superintendent by the three foremen and all the drivers of machinery at the close of each day's work. These are compiled into a daily cost sheet by the superintendent and handed to the city commissioner early next day.

The total staff of the department at the present time includes Superintendent T. F. Robbins, three foremen, six catch basin men and 15 teamsters on the monthly payroll, and 80 street cleaners and two drivers of machinery on the daily roll.

Sand Analysis—the Need for Standardization of Methods and Apparatus

AT the Convention of the American Waterworks Association held recently in Cincinnati, a paper—of which this article is an abstract—containing much information to sand users outside of the waterworks field was read by Mr. P. Burgess.

A few reasons for the necessity of standard methods are the increasing demand by engineers for better concrete sand specifications, the fact that the term "effective size" is not entirely satisfactory as applied to rapid-filter sand, and the confusion on the part of the manufacturers of sieves, who find it difficult to satisfy the specifications and requirements of engineers.

The economic features are evident in the case of concrete where the frequent weak and ambiguous specifications tend to increase the cost of the work and often to yield unsatisfactory results. From the filtration standpoint local sands are often available, but on account of lack of knowledge on the part of the local contractor, or on the part of the engineers in charge, such sands are seldom used. In consequence sand is often imported from considerable distance at an undue expense.

Much of the confusion has arisen from the arbitrary terms used by sanitary engineers, terms which have little or no significance to an ordinary contractor or the sand merchant in the business of sizing sands.

Confusion in Size Standards

Moreover, a further confusion has arisen from the endeavor to use the actual sizes of the sand grains rather than the sizes of the openings in the screens. It was early recognized and appreciated that there may be considerable variations in the sieve used for testing purposes in respect to the diameters of the wires and the spacings of the mesh. Consequently it was considered that the nominal spacings of the meshes per inch were of no consequence in determining the separation of a sieve. This view of the matter required a determination of the relation between the average diameter of the openings and the size of separation of a sieve, or more properly the determination of the actual size of separation of a sieve. Since few engineers have available the equipment required to standardize sieves, the results of analyses have been reported in many instances in terms of numbers of meshes or in wires per inch. This method of expressing results is indefinite and inaccurate, because wire cloth used in the manufacture of sieves frequently varies in the size of wires and number of meshes per inch.

Within recent years this difficulty has been appreciated by manufacturers, some of whom have endeavored to clear up the matter by producing standard testing sieves made in accordance with recent standard specifications and with certain arbitrary intervals of spacings between the individual units. By such means it is hoped to fix definitely the diameter of the openings in testing sieves. Recently the Bureau of Standards of the Department of Labor and Commerce at Washington has adopted standard specifications covering the manufacture of certain testing sieves; also, when solicited, this department stands ready to rate and standardize testing sieves at a nominal cost with a view of determining the actual average diameters of the openings.

Change From Sand Grain to Sieve Opening

The engineering profession should adopt a standard method and standard apparatus for making mechanical analyses of sands and gravels. It is believed also that simplicity and accuracy in reporting the results would be obtained by revising the methods commonly used at present to report such analyses. Possibly that feature which would tend most to clear up the situation would be to change the standard of measurement from the size of the sand grains to the size of opening in a sieve. In view of the fact that the coarser testing sieves such as are required for sand analyses can now be obtained with wires of very nearly uniform sizes and accurate spacings in both directions, it follows that such sieves will, within reasonable and sufficient accuracy, contain openings of certain definite sizes.

One of the difficulties to be encountered in such a change of standard would be to compare previous analyses with present or future requirements and conditions. Some years ago, at Philadelphia, a great many tests were made to determine the sizes of separation of two nests of sieves; also, to determine the relation between such sizes of separation and the diameters of openings in the screens. The average ratio of size of separation to size of opening was found to be 1.10 and was a constant within the limits of accuracy which can commonly be secured in making a mechanical analysis of sand.

Some of the finer sieves examined contained twilled cloth and not plain woven cloth. The average ratio of the size of separation of the twilled cloth to the average diameter of the opening in such sieves has been stated to be one reason why there is no constant relation between the diameter of opening and the separation of a sieve. As a fatter of fact, however, no difficulty need be encountered in obtaining plain woven wire cloth, even for the fine sieves, so that a nest of sieves may readily be obtained with a practically constant ratio of sizes of openings to sizes of separations throughout.

In determining the relation between the separations and openings in the sieves at Philadelphia, there were counted more than 250,000 sand grains and the work extended over a period of two months. The sieves were rated and re-rated until the curves of analyses obtained by examinations of the same sample of material by the two sets of sieves coincided throughout their entire length. Great care was taken, also, to secure accurate measurements of the diameters of the wires and of the number of meshes per inch in both directions, from several parts of the area of the cloth.

How to Help the Sand Contractor

Attention is drawn to the marked difference in engineering specifications and requirements for the preparation of sands used for filtration purposes. Frequently such specifications are limited to an expression of the maximum and minimum effective size and maximum and minimum uniformity coefficient. These terms mean nothing to the ordinary contractor who must furnish the material. It is obvious that the whole question of obtaining satisfactory material would be very much simplified if the specifications would read that a satisfactory sand would be one which contains not more or not less than certain specified quantities as separated by certain standard sieves. Such standard sieves would be available for the contractor, or manufacturer of the material, as well as for the engineer in charge of the work, who, under present circumstances and conditions, has the matter almost entirely in his own hands. This is true in regard to specifications for sand required not only for filtering material but also for any other purpose.

It is significant that the difficulties of the present situation are appreciated by some of the manufacturers of screens and testing sieves who have, in some cases, in their trade publications, gone into a discussion of testing sieves rather thoroughly with a view of meeting the demands of the engineering profession. The intervals between the wires of one company's sieves, or the diameters of the openings in the sieves, increase in a certain definite ratio, namely, the square root of 2, or 1.414. This ratio has certain obvious advantages because it permits the selection of sieves which give accurate ratios of separations of 1.414, 2, or 4 to 1.

It is believed that there would be a great advantage in simplicity of expression of results of analysis or in the form of specifications covering the preparation of filter sands if a statement were made to the effect that 10 per cent. of the sand passes, or shall pass, a standard sieve No. 35, or a standard sieve having an opening of 0.417 mm. in diameter, as compared with the usual statement that a sand has, or shall have, an "effective size" of 0.46 mm. Moreover, the term "effective size" has no significance whatever outside of its application to a filter sand, and, of itself alone, the term is of doubtful value as applied to sands such as are frequently used for rapid-sand filters. The range of sizes is believed to be much more significant.

Bonding Asphalt to Concrete

After making various unsuccessful attempts to apply asphalt direct to the interior of a concrete reservoir, a western engineer tried the expedient of first painting the concrete with hot coal car. After the asphalt had been applied it is said to have adhered so firmly that it could not be broken away without bringing off pieces of concrete.

New School Building at West Point Grey, Vancouver, B.C.

ILLUSTRATED herewith is a new school building now under construction at West Point Grey, Vancouver, B.C. The building, which is to have two storeys and basement, is designed for the accommodation of three hundred and twenty children. Special attention has been given to lighting, heating, and ventilating. The main entrance is in the south front. The corridors run east and west, and are well lighted from the staircase windows. There are to be eight class-rooms, each 24 ft. by 32 ft., four being on the west side, with a central entrance staircase, and four on the east. Cloak-rooms are placed at the exterior ends of the class-rooms, on the north and south sides. The balance of the building on the north side is taken up by an assembly hall. In the basement there are to be: boiler room, lunch-room, lavatories, and so on.

The building is of fire-proof construction, with reinforced concrete columns, beams, and floors. The exterior walls are brick and stone veneer, backed by 8-in. yellow tile. All the partitions are of yellow tile.

West Point Grey School, Vancouver, B.C., now nearing completion.

The corridors have San-san composition flooring, while the remainder of the floors are finished with edge-grain fir. The exterior is being built principally of red brick and stone dressings.

The general contractors are The B. C. Granitoid, Limited; the architects are Messrs. Twizell & Twizell, Vancouver; and the Clerk of Works is Mr. R. W. Bridge.

ONE cannot help but smile upon seeing in a contemporary, "Industrial Canada," the advice to spend money freely, whether one really needs the articles purchased or not, because it helps industry and brings back prosperous times. It is the business man and the manufacturer whom we want to stir up in Canada to-day, and how many of this hard-headed species would purchase articles merely for the sake of helping industry? We had given "Industrial Canada" credit for more sense than to be fooled by the will-o'-the-wisp of philanthropy.

Governor Walsh, of Massachusetts, has signed the bill that authorizes the construction of new State highways to the extent of $2,500,000. The roads will be built in the counties of Berkshire, Franklin, Hampden, Hampshire and Worcester, and are to be completed within the years 1915-1918 inclusive.

Methods and Costs of Concrete Pavement Construction*

By M. P. Taylor†

A CONCRETE pavement was built last year which covers practically the whole south side of the town of Des Plaines, Illinois, and comprises 40,000 sq. yds. with curb, underdrainage system, etc. All the pavement laid was on a 20 ft. roadway except one street approximately one-half mile long where it was 22 ft. wide and another street in the business district where it was 30 ft. wide for a distance of a few hundred feet.

General Description.—The pavement was given a 3 in. crown on the 20 and 22 ft. roadways, and a 4 in. crown on the 30 ft. The concrete was laid 5 ins. thick at the sides of the roadway, and 7 ins. thick at the crown. Longitudinal expansion joints ½ in. wide were placed along the curb, and transverse expansion joints ¼ in. wide were placed every 25 ft. The transverse joints were of the armored type, Baker steel plates ¼ in. thick being used for protection. All the expansion joints were filled with tarred felt. Steel wire fabric weighing 4 lbs. to the square yard was placed in the concrete as reinforcement. This is much heavier reinforcement than that generally used in this type of pavement. The wire fabric came in 50-in. widths, which were lapped 2 ins. in laying.

The pavement laid is of the one course type which, while inferior to the two course in some particulars, has fewer difficulties of construction than the later. The concrete throughout was mixed in a 1:1½:3 proportion. Washed gravel and torpedo sand were used for the coarse and fine aggregates respectively. Both materials were excellent, being clean and well graded; the gravel was hard and durable, and the sand coarse and sharp. The gravel used ranged in size from ¼ in. to 1½ ins. Both fine and coarse aggregates were supplied from two separate sources, the pits being located at Algonquin, Ill., and at Waukesha, Wis.

Under Drainage.—The underdrainage was taken care of by 4 in. vitrified drain tile, laid 1½ ft. beneath the base of the curb. This pipe was of the hub and spigot variety and was laid with open joints around which were placed coarse cinders. The ditch was then back-filled with cinders up to the elevation of the bottom of the curb, forming a foundation for the latter. The drains were connected to the sewer system through catch basins where convenient or direct. It is thought that this system will effectually protect the pavement against frost, which has proven itself to be one of the worst enemies of a concrete pavement.

Sub-grade.—The sub-grade was black loam and heavy clay, and as a whole seemed to make a quite desirable base for the pavement. The main trouble with the sub-grade was its tendency to retain water, so that after a rain it was usually some time before the laying of the concrete could be resumed. After the excavating was finished, the sub-grade was brought to its final place by rolling with a three-wheel steam road roller weighing 10 tons. The sub-grade was given a crown of 1 in. Most of the excavation, which totalled 16,000 cu. yds., was done with wheeled scrapers.

Laying Pavement.—The work of laying the pavement proper was started September 1, and finished November 30. Various delays were incurred in the course of construction due to bad weather, plant break downs, and delays in receiving material. It was attempted to eliminate the latter difficulty by procuring the aggregates from two separate sources over two different railroads, but, while this proved advantageous for other reasons, it failed to some extent in accomplishing the desired end. One paving gang started work September 1, and on September 17 a second gang was started; both these gangs were retained until the end of the work, and when one was unable to pave for some reason or other, it was employed on some other branch of the work. Two entirely different styles of concrete mixers were employed by the two gangs, and this gives a chance for some very interesting comparisons in both method of construction and results. Both machines were traction mixers of a type specially designed for paving work. One was a gasoline mixer which deposited the concrete in place by means of a chute, while the other was a steam mixer with boom and bucket. The steam mixer seemed the more reli-

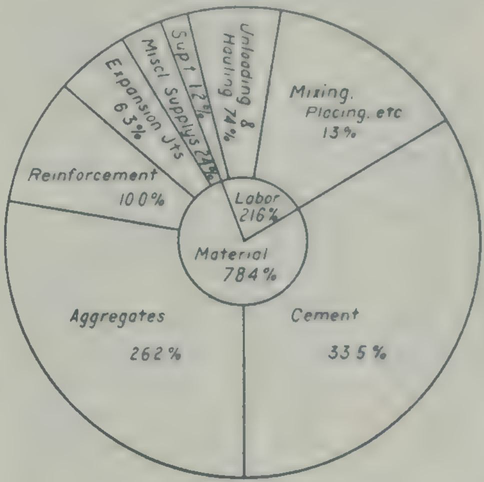

Fig 1

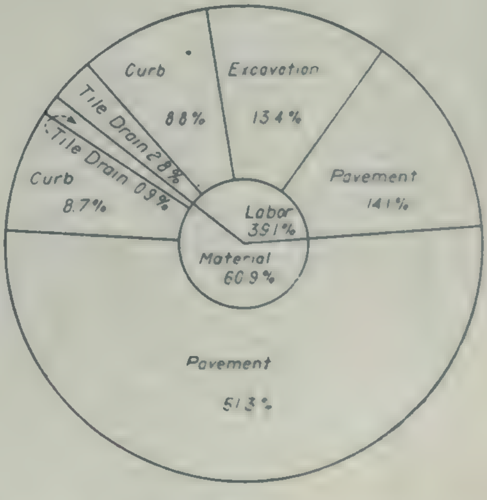

Fig 2

Fig. 1 and 2—Diagrams showing apportionment of costs of reinforced concrete pavement.

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*From Engineering and Contracting, Chicago.
†Engineer on Construction, Chicago, Ill.

able of the two, as more or less trouble was experienced with the mechanism of the gasoline mixer, though this may have been due to the unfamiliarity of it to the operator. The boom and bucket method proved to be the more satisfactory method of handling the concrete from the mixer, for the following reasons: (1) Less moving of the machine was required; (2) the concrete could be deposited more readily in the exact spot in which it was required; (3) a mixture of dryer consistency, which would have to be shovelled from a chute, could be handled readily. This last is an important point, as it is almost always a difficult matter to get the contractor to use as dry a mixture as desired, the wet mixture being more easily handled. On wide roadbeds especially the advantage of the boom and bucket is apparent. As a rule the gang with the steam mixer laid at least 25 per cent. more pavement in a day than the other gang. This was due probably to the reasons given above which allowed the concrete to be handled more rapidly. The steam mixer was 2 cu. ft. larger than the other in drum capacity, but this had no effect, as both machines used a two sack batch, which they both handled readily. The actual working time on the paving was 55 days. Of this time two gangs worked 26 days, and the remainder of the time only one worked. The average work accomplished in a day was 714 sq. yds. The greatest amount of pavement laid in one day was 1,538 sq. yds by both gangs, 818 sq. yds. by one gang, and 720 sq. yds. by the other. This is a very good day's work, but not remarkable. The average day's work of the gang using the steam mixer was 557 sq. yds., and that of the other gang was 417 sq. yds.

The materials were measured by the conventional methods employed in such work; the cement was measured in sacks and the aggregates in wheelbarrows, the capacities of which were first determined. Quite accurate results were obtained by these methods, the average variation from standard in the amount of cement used in the 25 ft. sections being about 5 per cent. This variation was probably due in some extent to slight unevenness in the sub-grade.

On a large part of the work the grades were very flat and, in order to allow the surface water to run off more freely, additional pitch was given in the gutters, which varied in depths from 3 ins. at the summits to 7 ins. at the inlets. This meant that between the summit and the inlet the amount of crown of the pavement was constantly changing. This change was effected in the 3 ft. of pavement nearest the curb on both sides of the street, the middle part remaining unchanged. Where it was necessary to do this the steel plates for the expansion joints were secured in three pieces, a 14 ft. piece (if on a 20 ft. roadway) for the middle and a 3 ft. piece for each side. The 14 ft. piece had the same crown as the middle 14 ft. of an ordinary plate, and the 3 ft. pieces were straight.

In most concrete paving work the surface is given its final form by means of a strike board, or template reaching from curb to curb. On this work it was impracticable in many places to use a strike board of the ordinary type on account of the construction described above where the cross section of the pavement was constantly changing in shape. Therefore a strike board was not used at all, and the concrete was struck off with a lute or float about 8 ft. long. This implement was made of 1 in. lumber and was about 4 ins. wide at one end, and 2½ ins. at the other. At the wide end it was provided with hand grips about 2 ft. apart. Two men each using one of these lutes worked behind each machine and brought the concrete to surface. Although very good results were obtained by this method, it is not to be recommended for the work as a general thing. It involves too much of the personal equation of the workmen; the results depend entirely upon the ability and care shown by the men who do the striking off. It requires men skilled in the work, and capable of detecting any slight unevenness in the surface by the eye alone; whereas a strike board shows up the imperfections mechanically and can be operated by laboring men of the lowest class. After the concrete was brought to its final surface it was finished by means of a small wooden float. This produced the ordinary "floated" finish. The finishing was done from a bridge in order not to disturb the surface.

Curing.—To prevent the concrete from drying out and hardening too rapidly, it was subjected to a curing process as follows: After the pavement was laid and had become so hard that the surface would not be damaged, it was covered with a layer of dirt about 2 ins. in thickness which was kept thoroughly wet for a period of eight days. This covering remained on the pavement for a period of 15 days, during which time all traffic was kept off the pavement. During the latter part of October and the first of November the weather was quite cool (although not frosty) and the covering was dispensed with, although the pavement was sprinkled daily for the period of eight days. A proper curing process is regarded as second to nothing in importance in the effect it has of developing the full strength of the concrete.

Unloading material	$0.02
Hauling material	0.058
Charging mixer	0.034
Mixing concrete	0.025
Placing concrete, reinforcement and joints	0.028
Bringing surface to final grade	0.015
Finishing surface	0.013
Curing pavement	0.015
Superintendence	0.013
Total	$0.221

Costs.—No minutely exact record of the cost of the work was kept, but the data given in the following table is available and is very nearly correct. The itemized average cost of the labor per square yard of pavement is given. This is for the pavement proper, the sub-grade being already prepared.

In the item "mixing concrete" is included the cost of fuel, oil, etc., for the mixer. All the other items given are labor only. The cost given for superintendence is for superintendence of construction alone. Of course there are overhead expenses which should be charged to superintendence, but it is only attempted here to show the field costs.

The accompanying diagrams have been worked out and show the costs of the work on a percentage basis. Figure 1 shows the cost of the pavement proper, and Fig. 2 shows the cost complete, including excavation, underdrainage and curb. These take into consideration all costs except overhead office expense and depreciation.

Street railway passenger traffic in Winnipeg has decreased to such an extent since the advent of the jitneys that the Winnipeg Electric Railway Company has been forced to adopt economic measures, involving the reduction in the number of cars, a reorganization of routes, and a probable reduction in staff.

The Use of Road Oils on City Streets

THOUGH the use of oil on the streets of Iowa cities is increasing each year, and is now pretty general throughout the State, results have not been satisfactory in all cases. Believing this to be due in a great measure to improper application of the oils used, Prof. T. R. Agg, of the University of Iowa, has prepared instructions for this work, and they have been published in a bulletin of the Technical Service Bureau of the State. In view of the general necessity for some form of dust prevention the instructions prepared by Prof. Agg have a definite value and they are reprinted below.

Kind of Oil to Use

The oils commonly offered for street work are obtained from petroleum, but oils from some other sources are available at somewhat higher prices than are paid for petroleum products. The petroleum oils are supposed to contain "asphalt," but whether any particular sample does or does not depends upon the source of the oil and what is meant by the term "asphalt." As a matter of fact, few of the road oils do contain "asphalt" if we use the term in the strict sense, but it is not important what we call the black sticky portion of a road oil. If the oil contains good "body" and possesses some stickiness, while being fluid enough to penetrate the road slightly, it will serve to lay the dust. For ordinary conditions the oils containing from 40 per cent. to 50 per cent. of so-called "asphalt" are best. In general, the oils are fluid and greasy and have little binding value, so that they cannot be expected to give a dense, closely knit surface. Some of the oils, however, do contain a sticky constituent which has a binding value and probably adds to the stability of the roads.

If the street be very sandy or is of gravel or crushed stone macadam, there can be no question as to the advisability of using an oil that is sticky and free from the greasy characteristics of the ordinary petroleum oil; nevertheless, fair results can be obtained with many of the petroleum oils if they are handled properly.

Preparation of the Street

If a street is to be oiled for the first time, preparations should be started some weeks before the oil is actually applied.

The effect of the oiling is to render the earth partially impervious to moisture, and if the surface of the road be uneven when treated or becomes uneven afterward the depressions will become basins for holding water. Traffic will gradually work the soil and the water thus retained into mud, to the serious detriment of the street. If the street be smooth and well crowned, the water will run to the gutters so quickly that only in long continued wet weather will the street be softened to any great extent, and therefore traffic will not make any considerable amount of mud on the surface.

The principal object in oiling a street is to prevent dust; therefore there should be no dust on the street when the oil is applied. If dust has formed, it must be removed, which costs something. It would be better to treat the surface before the dust has formed, if possible.

For the best results the street oiling should be planned ahead and the preparation of the street carried out in the early summer so that the oiling can be done before a layer of dust forms on the street.

Grading

Good results with oil cannot be expected on a flat and poorly drained street. Early in the summer the street should be carefully rounded up with an even slope from the middle of the gutter. The gutter or ditch should be deep enough to readily carry the water and to permit a slope of about an inch to the foot from the middle of the street to the gutter. Generally, the bottom of the gutter should be about eighteen inches below the middle of the street where the width of the street is not over 35 feet between gutters. This is about right on a residence street. On a business street having a width of 50 feet, the bottom of the gutter should be at least two feet below the middle of the street.

After the street has been shaped with a grader, it will undergo a period of settling, during which some depressions and uneven places will appear. These should be filled with earth and the entire roadway be kept dragged until it finally becomes hard and smooth and free from depressions.

It is very important to secure a firm, smooth surface for the oil, and the small expense incurred will be more than made up by the increased effectiveness of the oil treatment.

When the street has been brought to this stage it is ready for oiling. Usually the best time is during the latter part of May and during June. If the oiling is delayed until a layer of dust has formed on the street, it is best to scrape off most of it before oiling.

The decision to oil a street may sometimes be reached after the summer is well along and the streets have become hard and dry. In that event, it is not advisable to do any extensive earth work, because at this time of year newly placed earth will not compact readily, and if oiled before well packed the results are unsatisfactory. Such a condition is not ideal and only poor results can be expected.

Applying Oil

After the street has been prepared as described, the oil should be applied, the quantity being one-third gallon to one-half gallon per square yard of surface. If the street has never been oiled before, or if more than a season has elapsed since a previous oiling, the quantity used should be about one-half gallon per square yard, but if the street is being oiled regularly each season, about one-third gallon per square yard is sufficient after the first year. When the oil is being applied on a busy street in the business district it is necessary to oil every year, using about one-half gallon per square yard of surface for each oiling. In many towns the business streets are oiled twice a year.

An ordinary street sprinkler may be used for distributing the oil, and after a few trials the operator can get his spray adjusted so as to deliver about the proper amount of oil and spread it evenly. Care must be taken to secure a nice even distribution of the oil and to avoid forming pools or covering sidewalks and crossings. Many of the disagreeable features of street oiling can be avoided if care be taken to keep sidewalks and crossings clean. The crossings may be covered with dust or sand before the oil is spread so as to keep them clean. After the street has been under traffic the crossings may be cleaned and from that time no trouble will be experienced.

If a street sprinkler be not available for delivering the oil, a thresher or any similar tank can be used by attaching a pipe at the back for distributing the oil. The best pipe distributor consists of an 8-foot length of two-inch pipe made up with a tee at the middle and caps at the end. Along this pipe, tee included, should be drilled two rows of one-eighth inch holes one inch centre to centre in the rows. This pipe is connected at the rear of the tank so that it will hang about one foot from the ground, and parallel to it, the connection to the tank being made with two-inch pipe in which there is an ordinary blow-off cock or gate valve. A little better distribution will be secured if a "spatter" board is suspended just under the spray pipe so that the oil will strike the board and will break up into spray before striking the ground.

This will make it possible to cover the surface fairly uniformly instead of in streaks as will be the case if no board is used.

After the oil has been spread it should stand without being covered for about a day. Then it should be covered with just enough sand to keep the oil from picking up. Emphasis is placed on the importance of using sand for this purpose rather than dust from the old road surface. The amount of sand needed is only two or three loads per block, and at any reasonable price the benefits derived from the use of sand justify its use, wherever it can be secured.

After the road has been put in service, it may be apparent that more sand is needed in spots, and such places should be covered lightly, the covering being repeated two or three times if necessary. Use just enough sand to keep traffic from picking up patches of the surface.

When a residence street is oiled the second time, the method to be followed is exactly the same as is followed the first time, except that the quantity of oil used may be reduced to about one-third gallon per square yard of surface. It is advisable to repeat the oiling the second year in any case, though it may be omitted the third year and resumed the fourth year. Better results would be obtained if the work were done every year.

Results to Be Expected

Surface oiling finally results in a street covered with a layer of granular soil which is oil saturated and consequently does not blow about readily. The suppression of dust is the principal benefit to be expected. Beneath the thin layer of loose oil-soaked soil the firmer portion of the street is saturated with oil for a depth that varies from one inch to perhaps six inches.

Water penetrates this layer rather slowly. If the street has plenty of cross slope so that water does not stand on the surface, only a small amount of mud will form under light or moderate traffic. A street that is oiled systematically for a series of years gradually acquires an oil-soaked crust which becomes more and more impervious as the oiling is repeated. An oiled street never gets to the place where it will not be muddy in seasons of heavy rainfall, nor will the surface be stable in ordinary wet weather if the road carries heavy traffic.

Unloading the Oil From Tank Cars

The oils used for dust suppression can be purchased so much more cheaply in tank car lots than in barrels that it is always advisable to purchase in such lots. If the town be so fortunate as to have a siding or embankment 8 or 10 feet high, the car can be placed thereon and the oil allowed to run into the sprinkler wagon from the tap in the bottom of the tank car.

Usually such a siding is not available and in that case the oil must be pumped from car to wagon. For this purpose the ordinary tank pump used with traction engine tanks is as good as anything. It should be placed on top of the tank car with all connections made of pipe, as hose does not last long in oil. If a small steam or gas engine driven pump be available it will of course be faster than a hand pump, but it is not worth while to purchase one for a small amount of work.

Cost of Surface Oiling

The cost of preparing a street for the oil treatment may vary from 25 cents to $1 per lot 60 feet wide, but it is hardly proper to charge extensive earth work against the oiling. The street ought to be kept well shaped up regardless of whether it be oiled or not.

Some cleaning is almost always necessary prior to the oiling, which costs from 30 cents to 50 cents for each 60-foot lot where the street is oiled about 25 feet wide. The oil can be unloaded, hauled and distributed for about $2 per lot including the cost of covering oil with sand. The cost of the oil will be about $1 per lot, and the cost of sand about 25 cents per lot. The total cost for each 60-foot lot on each side of the street is as follows:

Cleaning the street	$ .40
Applying oil and covering with sand	2.00
Cost of oil	1.00
Cost of sand	.25
Total	$3.65

These prices are about an average and will serve as a guide in estimating the cost of work of this class. Oiling is often done considerably cheaper and in other instances has cost more. It is assumed that the application will consist of about one-half gallon per square yard of surface and that the oil will cost 4 cents per gallon.

Oiling Macadam Roads

When oil is used to prevent dust on a new broken stone or gravel macadam road it should be applied after the road has been well seasoned, but before traffic has brushed off the fine material from the surface. Usually a road will reach the proper condition within a year after it is built, but the time varies greatly. If allowed to go too long, the surface will be a little rough after oiling. If oiled too soon, a putty-like mat will form which will scab off the surface under traffic.

If an old macadam road is to be oiled it should be repaired and thus brought to a smooth even surface. It should then be placed under traffic just long enough to get a good texture to the surface before the oil is applied.

A macadam road is in the proper condition to oil when it has a true cross section and a uniform surface whose texture is close and compact but upon which there is very little loose binder, be it either sandy loam or stone screenings. If the surface be porous, the oil will penetrate too deeply and will interfere with the bond of the surface. If the surface be covered with fine material, the oil will mix with it and form a mat covering which is not durable.

It should be noted that the general statements made above apply only in those cases where a light petroleum oil is used for dust laying and not to the construction of macadam by the penetration method.

Tests were recently made at Columbia University, New York City, to determine the relative strength of concrete made with slag and with trap-rock as aggregate. The trap-rock was graded into ¾, ½, and ¼-in. sizes and smaller; and the sand was "Cow Bay," a typical product from Long Island. The mixture was a 1:2:4, and the test pieces were cured 28 days. The slag concrete, though the lighter in weight (140.6 lbs. per cu. ft., as compared with 154.5 lbs. for the trap-rock concrete), proved to be considerably the stronger of the two. Its compressive strength per sq. in. was 2,465.5 lbs., while that of the heavier trap-rock test was only 1,975.5 lbs.

Plans now completed by the Ontario Government for extensive road construction in northern Ontario contemplate the expenditure this season of $615,000 upon the work. The sum of $90,000 will be devoted to a highway along the route of the Temiskaming & Northern Ontario Railway, and $75,000 to a road along the Transcontinental Railway. A trunk road will be constructed from Sturgeon Falls to Sudbury. Apportionments for road-building are also made to various districts as follows: Rainy River, $35,000; Kenora, $25,000; Port Arthur, $40,000; Fort William, $50,000; Sault Ste. Marie, $50,000; Sudbury, $40,000; North Bay, $50,000; Nipissing, $35,000; Haileybury and South Lorrain, $55,000; other roads, $102,000.

Personal Mention

Mr. E. S. Mathieson, Amherst, N.S., has been appointed Town Engineer of Trenton, N.S.

Mr. E. J. Holland, City Engineer of Guelph, Ont., has been appointed Building Inspector, in succession to Mr. Lambert.

Mr. J. H. Kennedy, who has been in the service of the Vancouver, Victoria and Eastern Railway for fourteen years, part of the time as Assistant Chief Engineer, is retiring.

Mr. L. C. Ord, Works Manager of the C. P. R. Angus Shops, was elected President of the Canadian Railway Club at the recent annual meeting of that body held in Montreal.

Mr. George E. Templeman has been appointed Superintendent of Construction and Maintenance of the Montreal Electrical Commission, in succession to Mr. D. B. McIntyre, resigned.

A private cablegram from Mr. R. D. Brown, former City Engineer of St. Catharines, confirms an unofficial report that Private Walter B. Scott, Assistant City Engineer of that city, has been killed.

With the death of Mr. A. A. Cruickshank, the Government of British Columbia have lost a competent official. Formerly a contractor, Mr. Cruickshank was appointed Road Superintendent for the Chilliwack District in 1909, in which capacity he held the reputation of being the best road builder in the province.

A cable from London, Eng., announces the death at the front of Lieut. C. A. R. Tennant, of Montreal. He was connected with the firm of C. Tennant, Sons & Company, Montreal, Limited, a branch of the well-known British firm of iron and steel, wire rope and chain, cast iron pipe and chemical merchants.

Mr. W. T. Donnelly, of New York, Consulting Engineer for the Grand Trunk Pacific Railway, recently inspected the big G. T. P. drydock at Prince Rupert, B.C. He expects that this floating dock, which is estimated to cost $2,500,000, will be completed in a few weeks. The dock, which has a capacity of 20,000 tons, is 604 feet long and 130 feet wide.

Mr. W. J. Francis, C.E., of Montreal, is advising the city officials of Peterborough with regard to the city's new sewerage project. This work, which involves an outlay of a quarter of a million dollars, will include a pumping station to pump the sewage across the river to the disposal plant, and Mr. Francis has been called in to decide the best location for the pumping station.

Mr. James Barr, a member of the staff of the Toronto Civic Works Department, was among those who went down on the Lusitania. The late Mr. Barr, who was born in 1885, was a graduate of the University of Glasgow. He entered the service of the Works Department in 1910, and later became Chief Assistant to Mr. James Milne, Mechanical and Electrical Engineer for the city.

Mr. Thomas Adams, of the Commission of Conservation, Ottawa, is making a tour of the West, and spoke last week in Regina, Calgary, Swift Current and Medicine Hat. Mr. Adams in all cases emphasized the necessity of taking care of the growth of the cities in order that future populations should have no cause to complain of the way in which the cities had been built up, and said that the young cities of the West had only to profit by the experience of the eastern cities rather than to follow their example and grow up haphazard.

S. H. Mundheim, the German manager of the Cement Products of Canada, whose plant is located on the Island of Orleans, in the St. Lawrence, a few miles below Quebec, has been taken into custody by officers of the Alien Enemies Department, and will be interned during the period of the war. His German passport showed that he had held the rank of a captain in the German army. The plant of which he was manager employs many Germans, and has been constantly under military surveillance. No reasons have been assigned for his sudden arrest.

Mr. Robert Munro, for many years President of the Canada Paint Company, died in Montreal on May 22. Mr. Munro was a Scotchman, and in 1890 came to Canada to establish a branch of the Alexander Ferguson Company of Glasgow, paint manufacturers; subsequently he formed a company and bought the business, which was operated under the name of the Canada Paint Company, and for about fifteen years he remained with the concern as Managing Director, until the business was acquired by the Sherwin-Williams Company. He retired from active business three years ago.

Charles Leonard Weisner, for the last five years General Manager of the National Fire Proofing Company of Canada, Limited, died at his home in Toronto on May 15th. He was born in Buffalo, N.Y., in 1863, and located in Toronto eleven years ago, having been connected with several contracting firms until he became agent for the National Fire Proofing Company of Pittsburgh, Pa. Later, when the Canadian company was formed, he was appointed to the position he held at the time of his death. He was a member of the Engineers' Club of Montreal. He is survived by his widow, one daughter, and two sons.

Vancouver has lost one of its pioneers in the person of Mr. Walter Moberly, who died recently at that city. He was born in England in 1832, and came to Canada in 1842. His first experience as an engineer was gained on the Northern Railway, which was built to connect Toronto with Barrie and Penetanguishene. In 1858 he went to Victoria, B.C., and later he laid out the city known as New Westminster. He was employed in making the survey for the transcontinental line, and on the completion of these surveys Mr. Moberly took up his residence in Winnipeg, where he carried on his profession as an engineer and architect.

Grant, Smith & McDonnell, the contractors for the new piers being built for the Government at Ogden Point, B.C., are building additional cribs at Esquimalt. They intend to build three cribs together on the ways, and for this purpose the structure is being extended. Under the new arrangement it is expected that the work will be considerably facilitated, every modern means in the shape of machinery and material being available at the Rosebank quarries.

Another step has been taken in the direction of making a start on the construction of the new Union Station at Toronto. The obstacle that has been holding up the financing of the scheme has been removed by the City Council, though somewhat against their will. The G. T. R. and the city could not agree on one of the terms governing the railroad lease of the city's property, but the Council at last decided to accede to the demands of the G. T. R. in order to get the work started as soon as possible. Now that the transfer of the property in question has been arranged it is said that the Toronto Terminal Company will have no difficulty in financing the work.

The United States Cast Iron Pipe & Foundry Company are opening a new office in Kansas City, Mo., at 1404 R. A. Long Building. The new office will be under the charge of R. C. Clifford, formerly of the St. Louis office of this company.

Mainly Constructional

East and West From Coast to Coast

The City Council of Berlin, Ont., have decided to engage a competent engineer to report on the trunk sewer and to determine whether or not the construction is faulty.

Over $240,000 was spent by the city of Hamilton on road work under the local improvement plan last year. Sewer construction took $41,600, and $145,400 was spent on the construction of sidewalks and curbs. In few cases were the actual costs in excess of the estimates.

With capital stock of $40,000, Granite Concrete Block Company, Limited, have been incorporated at Toronto by J. A. Livingston, R. Robinson, M. Robinson, and V. M. Livingston. The company will manufacture and deal in cement block, burial vaults and other cement products.

The plant of the Union Cement Company at Brooks, near Owen Sound, Ont., began its season's operations last week. The company have completed alterations to the plant which will render the production more economical, and they expect a full season's run, in spite of the apparent trade depression now existing.

The Bowmanville Gravel Company, Limited, has been incorporated at Bowmanville, Ont. The provisional directors of the company are J. T. Marsh, A. C. MacNaughton, C. W. Livingston, and A. L. Shaver, and the company will deal in gravel, sand, crushed stone and other builders' supplies. The capital stock is $40,000.

P. O'Donnell, H. J. McNinley, M. D. Albert, J. McFeetors, and G. E. Buchanan have incorporated The New Ontario Concrete Building and Construction Company, Limited, at Sudbury, Ont. The capital stock is $40,000 and the firm will carry on a general contracting business and manufacture concrete blocks, bricks and pipes.

A party of business men and property owners of the town of Ingersoll, Ont., paid a visit of inspection to Aylmer last week, and gave special attention to the permanent brick and concrete roads of that town. The town of Ingersoll is seeking information on the paving question, and the visitors were favorably impressed with Aylmer's brick streets.

Messrs. Ewing, Lovelace and Tremblay, of Montreal, are making a complete survey, plan and levels of the town of Greenfield Park, Que., on the south side of the St. Lawrence, opposite Montreal. The officials have commenced a town planning scheme, and the data to be furnished is partly in connection with this scheme, and partly for the purpose of public improvements.

The first shipment of pipe sections for the new intake at Brockville, Ont., has just been placed on the job. It consists of eight 57-ft. lengths of 30-inch pipe, constructed of English seamless steel tubing. This material is practically unbreakable, and is far superior to the old cast iron pipe. The joints of the intake will be covered with concrete anchored to the bottom. Seven hundred feet of the new intake will extend under water and 150 feet will be on land.

During the present year the Montreal Harbor Commissioners will expend $2,000,000, of which $800,000 will be on the addition to No. 1 elevator, making that structure the largest elevator at any Atlantic seaport. The other work includes dredging of the south shore channel, the material being used for the construction of wharves; the building of a concrete roadway on the south shore, the extension of piers, the construction of berths, and the extension of the harbor railway system.

One of the largest contracts in the Province of Quebec this year, the Quebec Central Station for the C. P. R. and Transcontinental Railway, has been let to the Downing-Cook Company, Limited, Montreal. The plans have been drawn up by Mr. H. E. Prindle, of Montreal. The station will be two storeys high, of granite and brick construction. The steel work will be supplied by the Eastern Canada Steel and Iron Works, Limited, while the piling will be on the pedestal pile system of the MacArthur Concrete Pile and Foundation Company, New York.

The Lord & Burnham Company, of Irvington-on-Hudson, N.Y., are about to commence operations in their new $100,000 factory at St. Catharines, Ont., where they will manufacture materials for greenhouses, such as they now manufacture at their United States plant. The new plant will have an annual output worth from $350,000 to $500,000. It is equipped with iron and woodworking machinery and will give employment to carpenters, painters and glaziers, as well as men of other trades. It is said that the company will offer no opportunities to American interests in supplying future equipment, except in open competition with Canadian dealers.

The stonework for the large new filter bed at the sewage disposal works at Regina, Sask., has been completed for some time, and the city is now awaiting the delivery of the steel trusses from the Regina Foundry before completing the building. All the other materials are said to be on the ground. The new bed, which is rectangular in shape, will have double the capacity of the four round filter beds previously constructed. If the experiments in aerated sewage which are being conducted at the present time by Mr. R. O. Wynne-Roberts at the old power house prove a success, it is more than likely that the city will be relieved of the expense of constructing any more of these costly filter beds.

Although the constructional business in Montreal is still quiet, there are signs of a slight improvement in several departments. Trade in the Province generally appears to be fairly good, and this, in a measure, is reflected in the turnover of city firms who have country customers. A few important contracts have been let recently, notably those for the joint station at Quebec; a bath at Maisonneuve; a college at Laval des Rapides; St. Michael's parish church, Montreal; crypt of the Oratoire St. Joseph du Mont Royal, Cote des Neiges; wing of the Royal Victoria Hospital, Montreal; St. Denis Theatre, Montreal; Bloomfield and Bancroft Schools, Montreal; and a number of smaller schools and churches in the Province.

The Aztec Oil and Asphalt Refining Company of Canada, Montreal, have made a proposal to the city of Montreal to construct a plant, at an approximate cost of $2,000,000, providing that the city will agree to buy asphalt for a term of ten years at $16.45 per ton. The company, who are connected with the Interocean Oil Company, of New York, propose to manufacture the various by-products in addition to the asphalt. The Council have also received tenders for the supply of asphaltic material, together with samples. Prices range from $14.27 to $32 per ton, the lower quotation representing a considerable saving on the price under the contract which has just expired. New specifications have been lately drawn up, and the twelve samples sent in were submitted to Messrs. Milton, Hersey and Crossley, Prof. French, of McGill, and Prof. Haynes, of Laval. These experts recommend the acceptance of the tender of Mr. J. Baker, Jr., of New York, at $14.27 per ton.

The town of Cartierville, P.Q., is about to install a system of water filtration, plans for which have been drawn up by Mr. H. G. Hunter, C. E., of the New York Continental Jewell Filtration Company, Montreal, under the instructions of Mr. F. C. Laberge, the Engineer. The plant, built of reinforced concrete, will have a capacity of a million gallons a day, and is to be on specifications by the New York Continental Jewell Filtration Company, Montreal. The water will be drawn from the Ottawa River, the intake pipe running about three hundred feet into the stream. The plant will be located about 150 feet from the bank of the river. The water will flow by gravity into the plant and will then be pumped into a reservoir about one thousand feet distant. The town has purchased the piping system of the Montreal Public Service Corporation, which now supplies the town with water. The plant will consist of three filter units having an area of 125 feet of sand surface, two coagulating basins with a combined capacity of approximately 136,000 U. S. gallons, and providing for a coagulation and subsidence period of three hours, and a clear water basin having a capacity of 65,000 U. S. gallons. The contract includes the provision of a complete system of coagulation and hypochlorite of lime solution mixing and feeding apparatus. The pumping plant will consist of a low-lift motor-driven centrifugal pump, and a high-lift gasoline engine-driven centrifugal pump, each having a capacity of 700 U. S. gallons per minute. A rotary pressure blower will be geared to an alternating current motor.

Trade Inquiries

The Weekly Report of the Department of Trade and Commerce contains the following inquiries relating to Canadian trade. The names and addresses of the firms making these inquiries can be obtained by those specially interested in the respective commodities upon application to the Inquiries Branch, Department of Trade and Commerce, Ottawa:

621. **Heating apparatus.**—Catalogues and price lists of furnaces are desired by a Paris broker from Canadian manufacturers.

636. **Building material.**—A Paris concern desires quotations on every kind of building material, c.i.f. French port.

660. **Railway sleepers, telegraph poles and other lumber.**—A firm in Dundee desires the addresses of British Columbia manufacturers of railway sleepers, telegraph poles, and other lumber.

661. **Steel and iron.**—A Nottingham firm inquires for sections and joists in quantities. Contracts for 100 tons.

662. **Rolled steel joists.**—A Loughborough firm using approximately 5,000 tons of above per annum, in British Standard sections ranging from 5-inch by 3-inch to 24-inch by 7½-inch, to British Standard specification, is open to receive quotations from Canadian manufacturers.

663. **Steel and iron sectional materials.**—A Stoke-on-Trent firm is open to receive quotations for above, such as flats, angles, channels, etc.

665. **Steel.**—An Ipswich firm inquires for quotations on steel joists, angles, tees and flat steel in good quality steel.

666. **Steel.**—A firm in Leicester is open to receive quotations for steel joists, sections and plates.

667. **Steel channels.**—A Leicester firm inquires for manufacturers of 8, 10 and 12 inch channels, lengths up to about 36 feet. Also round mild steel bars up to 4 inches diameter rising by lengths and quarters and above 4 inches up to 6 inches or 7 inches rising by half inches.

669. **Steel.**—A Birmingham firm inquires for exporters of the following steel. Prices to be c.i.f. Liverpool, Birkenhead, Manchester, or c.i.f. their works—James Bridge Works, Darlaston. Steel to be British Standard specification for general building construction, as revised August, 1912, and to be well and cleanly rolled. Joists to be cold straightened in the usual way: Five tons joists, 5 by 3 by 11 pounds, in 12 to 20-foot lengths; 10 tons joists, 8 by 4 by 18 pounds, in 16 to 24-foot lengths; 10 joists, 12 by 5 by 32 pounds, 20 feet long (B.9); 10 joists, 12 by 5 by 32 pounds, 22 feet long (B.9); 10 joists 12 by 5 by 32 pounds, 24 feet long (B.9); 5 tons flats, 2½ by ⅜ inch, 20-foot lengths; 5 tons flats, 3 by ⅜ inch, 20-foot lengths; 5 tons flats, 3 by ½ inch, 20-foot lengths; 5 tons flats, 3½ by ⅜ inch, 20-foot lengths; 5 tons flats, 3½ by ½ inch, 20-foot lengths; 5 tons flats, 4 by ⅜ inch, 20-foot lengths.

The Charm of Quebec and the Maritimes

WITH the approach of summer there are many who are beginning to turn their thoughts to the annual holiday. With the pleasure grounds of Europe cut off from Canada and the United States, it is fair to assume that Canada will receive more attention as a holiday ground than ever before. For this reason the Canadian Government Railways (Intercolonial Railway and Prince Edward Island Railway) are to be congratulated upon the publication of a number of interesting booklets which set forth the charms of Eastern Canada. These booklets, which are well illustrated, contain full information as to railway and hotel rates; but, apart from this, they are informative and well worthy of the perusal of those who believe in "seeing Canada first."

Here is a tribute to Eastern Canada contained in one of the publications:

> A glorious summer country is Eastern Canada—a country which lies by the sea and is fanned by cooling breezes from the ocean. In this land are green hills, shady groves and fertile valleys. From the mountains the crystal brooks come leaping with the music of gladness, and join with the noble rivers in whose clear waters dwell lordly salmon and scarce less lordly trout. Near at hand are forests, as yet so little disturbed that the moose and deer, now and again, wander close to the farmyards of the adjacent settlements, and gaze in bewildered surprise at the man whose hand is raised to slay them. Along the shore for hundreds of miles lie land-locked harbors, where even the frail bark canoe may float in safety, yet be upon the waters of the ocean, and from the smooth sand beaches a child may venture into the buoyant salt water and fear not. In this country is scenery at times of sweet pastoral simplicity, at times of sublime grandeur. It is a land where civilization has made its way, and yet not marred the beauty of nature. It is a country where the traveller will find much that is novel, much that will charm, and much that will ever remain to him as a sweet remembrance of a pleasant clime.

One of these publications, "Summer Provinces by the Sea," is a book of over two hundred pages, which describes graphically the scenic features along the whole road of the Canadian Government Railways. Another is "La Baie de Chaleur," which sets forth the charms of this estuary of the Restigouche. Another is "Abegweit" (cradled on the waves)—a fine tribute to the attractions of Prince Edward Island. Another describes the scenic grandeur of Cape Breton Island.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Berlin, Ont.
City Clerk A. H. Millar will receive tenders until June 3rd for the construction of about 2,000 square yards of pavement. Alternative tenders are required on asphalt, bitulithic, and vitrified brick. Plans at office of City Engineer, H. Johnston.

Brussels, Ont.
The Village Engineer, John Roger, Mitchell, Ont., has been instructed to prepare plans for a permanent roadway and curbing. Clerk, T. S. Scott.

Tenders will be received until June 15th by the Village Clerk, F. S. Scott, for the construction of paving and curbing on Main Street. Plans and specifications at offices of Engineer, John Roger, Mitchell, and of the Clerk.

Cayuga, Ont.
Tenders on the construction of reinforced concrete pavement will be received until June 7th by J. W. Sheppard, Village Clerk. Plans and specifications at offices of Jackson & Company, Engineers, Temple Building, Brantford, and the Clerk.

Chatham, Ont.
Tenders will be received until June 8th by Joseph Gosnell, Clerk of Kent County Council, or Adams & Adams, Engineers, News Building, for the construction of a watermain from Emma Street to County House of Refuge.

Chatham Township, Ont.
The Township Council have had plans prepared for pumping and drainage systems. Engineer, W. G. McGeorge, 153 Queen Street, Chatham.

Hull, Que.
A by-law has been passed providing for the extension and enlargement of the watermains throughout the town. Approximate cost, $100,000. Engineer, J. A. Laforest.

Ingersoll, Ont.
The Town Council have decided to lay brick pavement on cement foundation on Thames Street, and plans for this work will be prepared. Clerk, W. R. Smith.

London, Ont.
Tenders will be received until 4 p.m., June 9th, by the City Clerk, Samuel Baker, for the construction of approximately 18,000 square yards of asphalt pavement on concrete base, 1,900 feet of 10-inch main sewers, and 2,200 feet of 6-inch private connections. Plans, etc., at office of City Engineer H. A. Brazier.

Mariposa Township, Ont.
The Township Engineer, A. G. Cavana, Orillia, will receive tenders until 2 p.m., June 7th, for the excavation and completion of a drain. Plans and specification at offices of Township Clerk, J. B. Weldon, Oakwood, and of the Engineer.

Marmora, Ont.
The Village Council are considering the installation of a water pipe system for fire fighting purposes. Estimated cost, $10,000. Clerk, H. W. Sabine.

Niagara Falls, Ont.
The City Council will call for tenders shortly on the supply of cement for paving on Robert Street. Clerk, W. J. Seymour.

Tenders will be called for shortly by the City Council for the construction of brick paving on Queen Street. Engineer, F. J. Anderson. Approximate cost, $16,000.

Orillia, Ont.
Tenders for the construction of sewers will be received until June 4th by C. E. Grant, Town Clerk. Plans and specifications at office of City Engineer, J. S. Blickensderfer, and of the Clerk.

Peterboro, Ont.
The City Council are receiving tenders on the construction of concrete, asphaltic concrete and bitulithic pavement on various streets. Engineer, R. H. Parsons.

St. John, N.B.
A quantity of 36-inch water main will be purchased by R. W. Wigmore, Commissioner for Water and Sewerage.

Stratford, Ont.
The City Council have decided to use lock joint sewer pipe in the construction of the projected main sewer. Engineer, A. B. Manson.

The City Council have passed a by-law to authorize the borrowing of $50,000 for the installation of a gasoline pumping plant and a water tower, 145 feet high, with a capacity of 500,000 gallons. Tenders will be called for by the Hydro-Electric Commissioners, Continental Life Building, Toronto.

Tenders for the construction of an elevated water tower of 500,000 Imperial gallons capacity will be received until June 25th by Ontario Hydro-Electric Power Commission, Continental Life Building, Toronto. Specifications and forms of tender with F. A. Gaby, Chief Engineer, care of Commission.

Windsor, Ont.
The City Council contemplate laying about 7 miles of watermains, varying between 6-inch and 20-inch in size. Secretary, W. A. Hanrahan.

Winnipeg, Man.
Tenders will be received until June 4th by M. Peterson, Secretary to Board of Control, for the supply of sewer pipe and specials. Plans and specifications at office of Engineer, W. P. Brereton, 223 James Avenue.

CONTRACTS AWARDED

London, Ont.
The City Council have let contracts for the construction of sewers to the following firms:—Connolly-Agnew Construction Company, 606 Avenue Road, Toronto, $38,900; W. McCracken, London, $5,500; Webster Construction Company.

Toronto, Ont.
The Board of Control have awarded the following contracts:—asphalt paving on Wellington Street West, to Commissioner of Works, R. C. Harris, City Hall, at $18,797; asphalt paving on St. Nicholas Street to Godson Contracting Company, Manning Chambers, at $1,165; concrete curbs on Wellington Street to Standard Concrete Paving Company, 18 Carey Road.

The contract for the construction of Argyle Street storm overflow sewer, Section No. 3, has been awarded by the Board of Control to Orpen Company, Limited, 165 King Street W., at $44,000.

Vercheres, Que.
The general contract for the erection of a bridge has been let by the Municipal Council to J. Trudeau & J. E. Messier, Varennes, Que. Approximate cost, $3,000.

Westmount, Que.
A contract for asphalt paving has been let by the City Council to Warner-Quinlan Asphalt Company, 745 St. Catherine Street W., Montreal.

Railroads, Bridges and Wharves

Blanshard Township, Ont.
Tenders will be received until June 7th by the Township Clerk, J. H. Q. Jamieson, R. R. No. 6, St. Mary's, Ont., for work on two bridges on Base Line. Work to consist of painting abutments and the construction of cement flooring.

Broadview, Sask.
Tenders will be called for shortly for the construction of a subway at Ninth Avenue and Front Street for the C. P. R. Engineer, J. C. Holden, Divisional Engineer, Winnipeg. Approximate cost, $65,000.

Cape Breton, N.S.
Tenders will be received until June 8th by J. W. Pugsley, Department of Railroads and Canals, Ottawa, for the construction of eight bridges on main line of Intercolonial Railway, Sydney Sub-Division. Plans and specifications at offices of Chief Engineer, Moncton, N.B., Resident Engineer, Glasgow, N.S., and the Secretary, Ottawa. Reinforced concrete construction.

Lorne Township, Man.
Tenders for the construction of seven or eight tile and timber bridges will be received until June 5th by Damien Labossiere, Municipal Office, Somerset, Man. Plans and specifications with Mr. Labossiere, and at Public Works Department, Winnipeg.

Milton, Ont.
Tenders for the construction of a ce-

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The Activities and Inactivities of the City of Montreal

ONE of the immediate results of the outbreak of war was the practical cessation of activities in relation to municipal expenditure. In some instances schemes were postponed, in others works were stopped, and there was a disinclination to consider any outlay except that which was imperative. Since that date there has been a decided change in the direction of a more liberal expenditure. A comparison of the notices in the Tenders and For Sale Department of The Contract Record indicates that municipalities are gradually increasing their appropriations.

The war has served a useful purpose in that it has forced municipalities to take stock and to examine more closely into their expenditures on improvements. In the boom period there was a tendency to make lavish outlays without a due consideration of the financial obligations which were being incurred, and to run up heavy bills without considering the cost. In the West the rivalry between cities has not been without its influence. We have been going too fast, and now that Great Britain is perforce obliged to discontinue lending us money on such a liberal scale a halt has been called. To a certain extent the United States has supplied the deficiency, but it may be taken for granted that the borrowing by municipalities will be restricted in view of the European situation.

Undoubtedly by far the greater proportion of the borrowed capital has been spent on necessary and reproductive schemes, but one cannot ignore the fact that in too many instances debts have been incurred too willingly, and that there has been a large amount of waste. The city of Montreal is an example of a city with an ever-increasing debt combined with methods of expenditure which are open to serious criticism. Although there has been an improvement since the days of the Cannon inquiry, there is still a large leaven of the aldermanic system which made for outrageous expenditures in the different wards. The appointment of Controllers curtailed the pernicious system of patronage under which the aldermen were constantly manoeuvring for heavy outlays in their particular districts; but the hands of the Controllers are still partially tied owing to the opposition of many aldermen, who regard with disfavor the powers of the Controllers, and who are anxious to return to the good old days when they exercised patronage. Efforts have been made to curtail the jurisdiction of the Controllers, but fortunately Premier Gouin was wide awake enough to veto the proposed charter amendments and to counteract the lobbying of the reactionary aldermen.

The enormous increase in the expenditure of Montreal is shown in a return just compiled by the City Comptroller. In five years the debt has more than doubled; in December, 1909, the consolidated debt was $36,029,995, while in December, 1914, it was $78,304,020—an increase of $42,274,025. It is estimated that the debt per head is $150 against $66 five years ago, part of this increase being due to the annexation of outlying districts. While much of the borrowed money has been well spent, any one acquainted with the later municipal history of the city, and with the scandals which have surrounded certain public works, can give a pretty shrewd guess at the enormous waste—to put it mildly—that has accompanied this heavy increase in the public debt. The city has added to its pay-roll of employees at an alarming rate; in 1908, 166,396 people were employed, the cost being $2,641,-

011; in 1914 the figures were 556,222 and $8,635,700. The situation has become so serious that Controller Hebert, who is responsible for the finances, predicts a deficit, when the interest charges are paid. Here is an instance of a city going at too great a pace, and of adding millions upon millions without looking to the future. The depression has forced the city to limit its outlays on improvements, and it has had to omit from the budget many works which were at first proposed. The aldermanic interference with the Controllers' reports has been so continuous that, as a way out of the friction which naturally follows, it has been proposed to abolish the Council, substituting for it a body of well-paid Controllers, experts in various phases of local government and engineering, who will each be responsible for the management of a particular department. The present plan of divided control has not been a success, and as the old aldermanic regime is an impossible one, from the point of efficiency and of spending money on improvements to the best advantage, the appointment of several business men to run the city on business lines is at least worth a trial. Two or three American cities have decided to adopt the "pay-as-you-go" system of administration—to pay for improvements out of revenue instead of borrowing. Although this has decided disadvantages, at any rate it would prevent the accumulation of huge debts, the interest on which is a serious burden to the citizens.

The Economy of Testing

THERE are certain bed-rock truths which have been established by experience and the test of time. It would be very foolish to proceed in a contrary direction unless one courted disaster, or at least a partial failure. It is not always a question of the use of the right materials, but of their quantity and quality. A ton of clean ballast and a hundredweight of cement will not make a good floor any more than dirty sand and poor lime will make a good ceiling. It is evident, therefore, that there must be great economy in following the results gained by testing. By testing one gets to know, and the accumulation of this knowledge allows of the carrying out of work on right and safe lines. It is known, for instance, that the design of a certain pipe for a certain purpose under certain conditions should be of such a material and of such a strength, because past experience has taught that it should be so; but a further test is required. The pipe may hold up to all the proper dimensions, and may look very good, but it is necessary that it should also be tested in its working position. In a recent case iron water pipes were cast and tested at a foundry under the supervision of an inspector. The pipes were struck with a hammer in all their parts while under pressure, and test bars of the metal actually used were also carefully proved. Subsequently the pipes when laid were tested in the trenches by hydrostatic pressure to 50 lbs. to a square inch above the working pressure, the result being that 460 10-in., 89 6-in., 97 4-in., and 10 2-in. pipes, weighing about 141 tons, or over 8 per cent. of the total weight delivered, were rejected. Can any one but a town surveyor realize what it would have meant to have lived in that town had the final test not been carried out before the system was completed? Rule of thumb, or "having a shot at it," may be an easy way of taking up responsibility, but it is not usually economical. As one cannot take the cover off the earth and see the conditions below, it behoves us to use the boring tool or the sunk shaft to ascertain as much as we can. It has been said that 70 to 80 per cent. of the failures of works subject to earth pressure are those constructed in clay, and most of the failures of reservoir dams have occurred through the movement of the clay foundations. We may be sure that had such clay been known to be treacherous it would not have been relied upon. Settlements and other mishaps frequently occur from buildings being erected on unknown foundations, whereas such happenings would be prevented if adequate investigation and trial were made of the ground previously. On the other hand, the extra careful rule-of-thumb man may cause great waste of materials by ignorantly overdoing the necessary margin. Knowledge leads, of course, to a great saving in expenditure, allowing as it does a sufficiently large—but not too large—margin of safety.

A definition of dirt is "matter in the wrong place;" in many instances this would be a good definition of waste, too—a waste caused by the use of unsuitable materials. Failures in road surfacing, failures in roof covers, failures in wall painting, and the rest, are evidences of the lack of testing or experience. The good soldier is the man of tested qualities, upon whom his General may rely. It is economical to employ such a man—he is worth many untrained, untested, raw recruits. It is the same in the engineering sphere—we shall be best served by using materials that have stood the test—bricks from the good brickyard, granite from the good quarry, pipes from the good foundry. There is no economy in using bricks which are affected by frost, or granite that pulverizes under the steam roller, or pipes that burst under working pressure, because they may be cheap to buy. How are we to be sure of the quality of our materials? Only by testing, carried out either by ourselves or by others upon whom we may rely. How often the engineer and surveyor sighs for an expert opinion on some material which he would like to use but which he has had no opportunity of testing himself. He dare not risk it on the recommendation of the interested purveyor, although it may possess the merits claimed for it in the lurid leaflet. Where a material or system has been tested thoroughly by a careful, disinterested investigator it would be most valuable if the result could be scheduled in some permanent way for the use of official engineers—in which case the length of the visits of various commercial travellers would be much curtailed. Then a reference to the suggested schedule concerning some material or process—for which every excellence was claimed—would show the opinion of the expert investigator, and his verdict, "unsatisfactory," "inferior," "not reliable," "good," "excellent," as the case might be, would lead to a great saving in time and trouble, to say nothing of future heartburning. It may be contended that the technical press at the present time does print a good deal of information on these lines. That is so; but it is not in [illegible] province of that press to do what is needed, especially in the matter of protected articles. Life is short, and it seems a pity for knowledge acquired through laborious hours to be lost, and for man after man to tumble into mistakes which could be avoided by a reference to a book of duly recorded investigations or observations. Just as the tradesman finds it economical to test the suspiciously new-looking florin that may be tendered to him, so the engineer would find it economical to test the new materials—as well as the old—that may be offered for municipal consumption.—The Surveyor, London, Eng.

Assessing the Cost of Water Main Extensions by Municipally Owned Water-Works

By D. A. Reed[†]

FEW subjects are of more general interest to the officials of water departments than the methods employed by various municipalities in the assessing of the costs of water main extensions. The procedure at Duluth, Minn., is here described. The method is simple and rational, and is easily applied.

An improvement of any kind which is largely local in nature—that is, one which from the nature of its construction is largely an accommodation to the abutting property—is found in lateral sewers and water mains of minimum capacities supplying or serving local properties only, which do not provide capacities in excess of local requirements, and which are not indispensable for serving more distant territory.

A city-owned utility usually has the power to assess certain benefits, whether the party interested chooses to be a consumer or not. Applying this fact to sewers and water mains the proper method would be to assess the cost of construction, or, in other words, the capital investment, against the property that it is possible to serve. The costs of operation, however, should be levied against the parties purchasing the output or using the service.

In the case of a municipal water supply these matters seem to be much easier of solution, and it seems quite practicable to assess the costs of construction directly upon the property susceptible of being served, and to assess the operating costs directly upon the customers or patrons of the utility, in proportion to the quantity of water consumed. This condition, it must be observed, is not met entirely by a rate charged upon a demand and output basis such as is in effect in New Orleans, for the reason that the demand charge does not extend to vacant property.

This fact will appeal to those who believe that vacant property should not escape taxation for any improvement that directly enhances its value. It would also seem to be a fair check or restraint upon interests that invest in idle property with a view to gain which results largely from the activities of others.

It is assumed that a municipal water plant should be self-sustaining in every sense of the word. It should neither give nor receive any benefit or consideration of any kind from the taxpayer, the city, or the individual.

A water main in which the size is in excess of the minimum may be classified as serving two purposes—the service to the property directly abutting, and the service to properties located more distantly from the source of supply. In the first instance, for the purpose of this discussion, a 6-in. service may be considered as sufficient, and all sizes in excess of 6 ins. for the additional service to those more distant. Assessments against abutting properties for the 6-in. main are easily applied. For costs of main in excess of this size the only practicable way appears to consider the additional cost as a part of the general distribution system, the expense of which has to be absorbed by the utility and included in the consumer's rates chargeable as operating costs. The direct assessment to the abutting property for the 6-in. main (this size being used as a matter of convenience) may be assessed against the abutting property by means of either of two methods: first, in the total, on the completion of the work, which is paid by one assessment; second, the principal being furnished from the funds of the utility, a percentage may be assessed annually against the property to cover interest and sinking fund upon the investment. After a term of years the percentage assessment will have returned enough money to the utility to cover the principal as well as the interest upon the investment. Ordinarily the vacant property thus assessed should continue to pay the assessment for the full term of years necessary to wipe out the original costs. Improved property, using water and paying for it upon meter rates, would be entitled to some credit or rebate on account of these rates, especially if the rates are based upon capital investment expense as well as upon operating costs upon the entire plant. Assuming for the purpose of illustration that one-half of the water rates are to cover interest and sinking fund expense, and that the balance is to cover operating costs, including depreciation, it will be found necessary to credit one-half of the customer's water rates against his assessment. This credit will ordinarily retire the annual percentage assessment upon improved property, unless the cost of constructing the extension was large and the consumer's consumption was low. If his consumption is considerably more than necessary to wipe out his individual assessment, the surplus, of course, should be applied pro rata to lessen the tax upon the vacant property. It is quite possible for the consumption on an extension to increase to such an extent that the overplus of credits will be sufficient to retire all the assessment against the vacant property upon that particular extension—in which case, having reached that point, all assessments should be discontinued, as the customers are carrying the entire expense of the extension, including capital investment as well as operating costs. This may be accomplished even at the end of one year or two years, or possibly ten or fifteen years, depending upon the rate of the percentage assessment against the property, the interest and sinking fund factor in the rates charged for the water, and the amount of the consumption upon the extension.

It is also quite possible that an extension may be made where there is no consumption for the first year. In this case all the property pays the percentage assessment with no credits, and the utility receives the exact amount necessary to pay interest and sinking fund charges.

The method employed at Duluth, Minn., in which a gas utility is also operated in connection with the water system, the pipes being laid in the same trench, has been to assess annually against the abutting property 8 per cent. of the total cost of each extension as represented by a 4-in. gas and a 6-in. water main, it having been established that sizes in excess of these dimensions would be more or less of a general benefit to all customers and property and permit of the strengthening of the system to benefit other customers

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[*] Abstracted by Engineering and Contracting from a paper before the Annual Convention of the American Waterworks Association.

[†] Manager, Water and Light Department, Duluth, Minn.

outside of those served by that particular extension. The proportion of charges against the abutting property has been based upon 5 per cent. for interest and 3 per cent. for sinking fund, assesed annually for a period of fifteen years. A 3 per cent. contribution to a 4 per cent. sinking fund, however, will not retire the principal in less than 22 years, but for various reasons it has been considered advisable to limit the duration of annual assessments to a fifteen-year term. A special discount of 25 per cent. is allowed to those paying the total amount in one payment. These assessments are made according to the frontage of the lot, without reference to its depth. However, the frontage of the lot is not considered necessarily as being the side abutting on the street upon which the extension is made; it may lie parallel to the mains and front on another street. It is assessed the same as other lots of the same frontage dimension. Subsequently, if mains are laid in front of the short side, no assessment is made therefor on this particular lot, which of course can receive no benefit from a second extension. Against this assessment is credited one-half of the water and one-third of the gas rates paid by the occupant of the premises, it being estimated that these proportions are necessary factors in a rate that will yield the proper amount of revenues for maintaining and operating the plant.

The principles and results involved in the methods as outlined above seem to be as follows:

1. All charges, whether of installation or of operation against property or a customer, are based upon actual cost.

2. Costs of distributing systems are ordinarily borne by abutting property except when the consumption is sufficiently large to assume the whole or part of this expense, when the charge is gradually transferred to the customer.

3. The customer bears operating costs and such installation charges as cover reservoirs, pumping machinery, stations, intakes, and the larger distributing mains.

4. As the municipal plant increases in size and in the amount of its revenues, its percentage of indebtedness will gradually decrease, and the proportion of interest and sinking fund in the rates charged for water will decrease until eventually, when no indebtedness exists, this factor will become zero and there will be no credits against the assessments. They will have to be met in full cash payments, or the consumer may discount the entire amount of his individual assessment by paying cash, taking advantage of the 25 per cent. discount.

5. The percentage plan enables the small property owner who is a consumer to obtain extensions on very easy terms, with practically no additional expense over and above the regular water rates.

6. It seems to be a practicable way for real estate owners to secure extensions of gas and water service in newly platted additions without throwing any of the burden upon the utility or its customers.

7. It furnishes a profitable investment at 8 per cent. net for the sinking fund of the department until the time arrives when it will be needed to retire bonds, at which time, if the money or any portion of it cannot be withdrawn, refunding bonds or new bonds in whole or in part may be issued. Eventually, if the rates for service have been established correctly, the time will be reached when its entire indebtedness will be retired. This will be true if depreciation and maintenance have been provided for in the operating expenses as well as interest and sinking fund on the indebtedness.

Munitions of War from Canadian Sources

THE manufacture of toluol has been commenced, for the first time in Canada, at the works of the Dominion Steel Company at Sydney, N.S. Toluol is a by-product of coke ovens, and is used in the manufacture of high explosives. The production of lead in Canada for war purposes has now reached 60,000 tons. It comes from Trail, B.C. Consideration is still being given to the proposal to refine copper in Canada, and it has been pointed out that the freight rate on copper matter shipped to the United States refineries is $10 a ton, in addition to duty. Refined copper is also subject to a duty on re-entering Canada. It is believed that the establishment of a copper refinery in Canada would serve as a regulator over foreign combines.

A peculiar penstock failure occurred recently at a station in northern New York. A 9-ft. steel penstock, 2,000 ft. long and under 200 ft. head, supplied two generating units, but had no surge tank connected to it. Two inclined branch pipes, closed with blank heads, were left for supplying future machines. Pressure-relief valves were depended on to prevent excessive water-hammer and assist in the speed rgulation of the generating units. From some unknown cause an extreme surge was set up in the penstock, and the hammer blew off the blank cover of one branch pipe. A 3½-ft. stream shot up, broke through the roof, and spouted in a curved jet which excavated a big hole in the ground some distance away. The plant was temporarily flooded, but the damage, except for the hole in the roof, was much less than might have been expected.

Collections of garbage are made bi-weekly in the business and weekly in the residence districts of Victoria, B.C. In the business districts a charge of 8 cents per can of 3½ cubic feet is made for collection; but this does not cover the cost, as the whole district has to be gone over, while collections from a large number of houses are still made by private scavengers. Recently a Peerless truck has taken the place of five carts in collecting and has resulted in a saving of labor cost of about 15 cents per ton. The average cost of collection of garbage from the residential districts, on the basis of one cubic yard weighing 1,350 pounds, has been $2.54 per ton, delivered at sea, as against $2.83 for the preceding year. These figures do not include overhead expenses or depreciation on equipment or buildings. The total collections for the year were 18,720 tons.

The power house, dam and transmission line were constructed by the Hawkesbury Electric Light and Power Company, by day labor. The power house switching equipment was supplied and installed by the Canadian Westinghouse Company. Generators, transformers and exciters were supplied and installed by the Canadian General Electric Company. Water-wheels were supplied and erected by Canadian Allis-Chalmers, Limited. The submarine cable was supplied and installed by the Canadian British Insulated Cable Company.

The Consulting Hydraulic Engineer on the work was Mr. Wm. Kennedy, Jr., of Montreal, and Mr. L. A. Herdt, D.Sc., was the Consulting Electrical Engineer, assisted by Mr. E. Godfrey Burr, Electrical Engineer, Montreal.

Power house under construction.

Construction of Power House and Dam at Cedars Rapids, Que.

ONE of the outstanding features of the industrial growth of Montreal has been the rapid demand for electrical energy for lighting and power purposes. The city is in the fortunate position of having excellent water powers within comparatively easy distances, allowing of low cost of operation and cheap energy to the consumer. By far the most important scheme of recent date is that carried out by the Cedars Rapids Manufacturing and Power Company, in which the controlling interests are held by the Shawinigan Water and Power Company and the Montreal Light, Heat and Power Company.

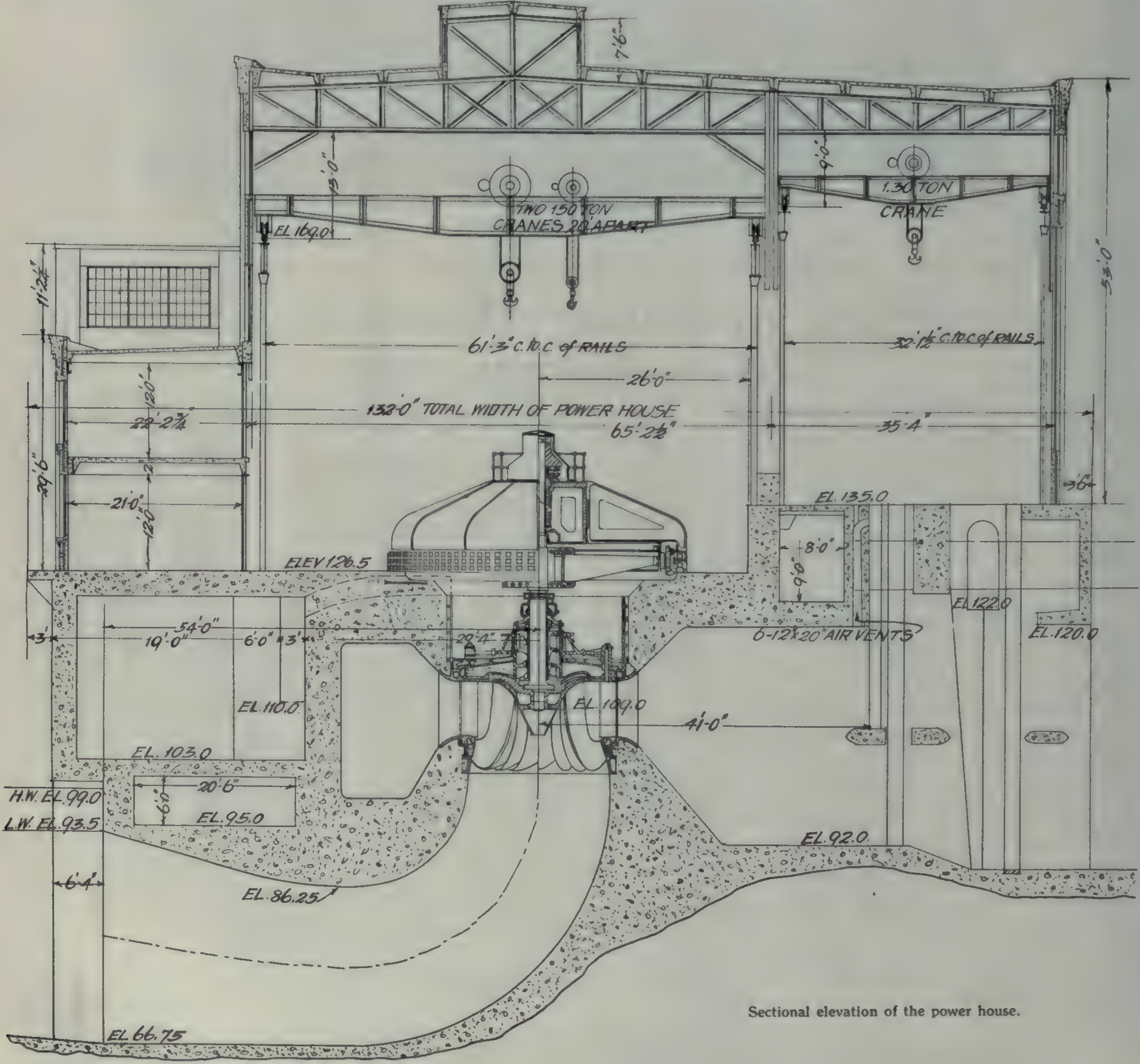
The development is at Cedars Rapids, on the north side of the St. Lawrence River, near the village of Cedars, about thirty-five miles west of Montreal. The Dominion Government granted a lease dated January 6, 1906, authorizing the company to take from the flow of the St. Lawrence an amount of water equivalent to 56,000 cubic feet a second, sufficient to develop a total amount of 160,000 horse-power. It was also found necessary to submit the plans to the International Waterways Commission, in order to avoid any interference with the provisions of the treaty with the United States Government, under which any diversion of the waters of the St. Lawrence must have the consent of the Commission. This consent was given on April 19, 1909. The water rights at the point are in the hands of the Provincial Government, and on August 2, 1910, a lease from this Government was signed.

Prior to the drawing up of plans an immense amount of work was done in the way of securing data as to the flow of the water. It was established that the flow is remarkably steady, the ratio in the highest and in the lowest years being three to one. At low water the flow of the St. Lawrence is in the neighborhood of 170,000 cubic feet a second, and the normal minimum flow is about 350,000 cubic feet a second. The minimum head of the plant occurs at low water. The minimum which has occurred during the last fifty years is 30 ft. The extreme fluctuation, taking into consideration the available data, would be from a minimum head of slightly over 29 ft., when operating under full load with thick ice covering in the canal, to a maximum head of about 34 ft. at a time when the plant is shut down through any cause, with no water flowing in the canal, combined with extreme high water conditions in the river. An exhaustive study of the

Tailrace and power house from the east.

fluctuations in the head at the point where the power house is situated has demonstrated that the formation of ice in the river affects the head at the plant only slightly.

In order to avoid interfering with navigation on the St. Lawrence, the plans were drawn so as to use part of the river as a canal. The power development covers an extent from east to west of a little over two miles. The northerly bank of the river is used as one side of the canal, while the south side of the canal is constructed at a distance of about 900 feet from the bank. A small island—the Ile-aux-Vaches—forms the upper end of the south bank, which extends to the power house at the downstream end. This south bank lies wholly in the river bed, a considerable portion being in very swift water. Before the construction of this dyke water flowed round the Ile-aux-Vaches; the amount of water flowing between the Ile-aux-Vaches and the mainland at low water of the St. Lawrence was in the neighborhood of 80,000 cubic feet a second. As the amount of water granted by the Government license is a little over 56,000 cubic feet a second, the difference of 24,000 cubic feet a second is forced to flow through other channels of the river.



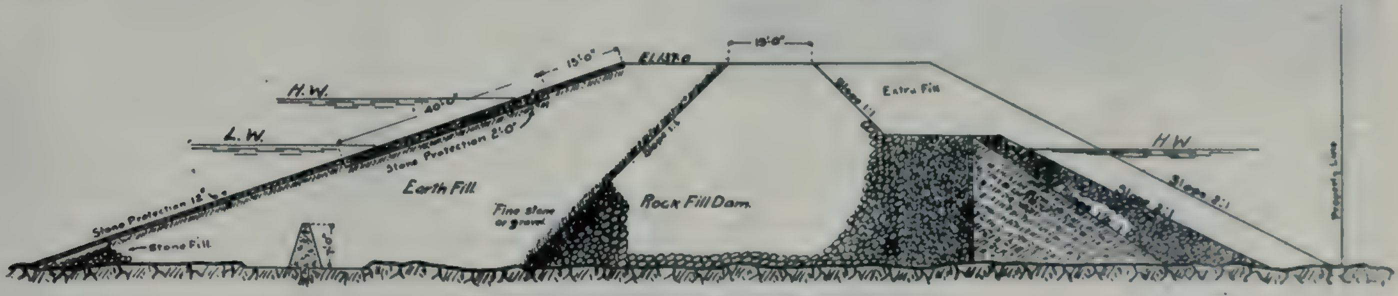
Sectional elevation of the power house.

The method of construction of the south bank was as follows: The crib work was constructed through the rapids and filled with stone. This crib work was sheeted on the outside and the sheeting made tight, and the whole strip lying between the crib work and the natural shore of the river was pumped out. The material was deposited behind the crib work, and the bank gradually built up. Finally a trestle was constructed in the centre of the bank, and rock fill was dumped off from the trestle. After the rock fill had been completed the earth blanket on the canal side was proceeded with. Before the construction of the bank the river bed was stripped over a section of the south bank and the core wall was built in this excavation, with the object of increasing the creepage distance under the bank and of making a tight connection to prevent the possibility of leakage. On the front face of the rock-fill selected clay was placed, washed down with streams of water. When the clay had consolidated, the outer layer of rock riprap, consisting of selected stones, was placed by hand.

In order to use the bed of the river it was necessary to straighten out the north shore line by cutting off the salients. By the removal of these points, and with the excavation in the canal necessary to bring the bottom to the proper level, sufficient material was provided both for the south bank and to construct dykes along the north bank at points where the natural levels were not sufficiently high to take care of the water conditions.

The same general type of construction was used in these dykes in the north bank, although in general they were much smaller and consisted only of short lengths to cross gulleys. A drainage ditch was constructed along the whole length of the north bank for the purpose of drawing off any water which formerly flowed into the river, carrying this water to a point below the power house. In the excavation of the canal and the construction of these banks 1,730,000 cubic yards of earth were handled and 650,000 cubic yards of rock (place measurements).

In order to concentrate the pressure of the water on the water-wheels, it was necessary to construct a dam at the end of the canal. This dam forms the foundation of the power house, the water-wheels being set in the dam itself.



Cross section of the dam at the south bank of the canal.

The following are the dimensions of the canal: width at bottom, 600 ft.; side slopes, practically 3:1; width at top, 800 ft.; depth of canal at minimum stages of St. Lawrence, 30 ft. The velocity of water under the worst conditions of low water and ice covering is 4 ft. a second, and the calculated loss of head in the canal under these extreme conditions is about 1.5 ft.

The power house is located across the end of the canal. It is of steel and concrete construction, built on the unit system, which was described in detail in a previous issue of The Contract Record. The slabs were cast in a casting yard about a mile from the site, and set in the steel frame by means of a crane. The walls are 12 ins. thick, consisting of two 4-in. reinforced concrete slabs, with air spaces of 4 ins. between. The substructure is 700 ft. long and 130 ft. wide. In this substructure are moulded the scroll cases for the ten main units and three exciter units. The draft tubes are also moulded in this concrete. The water-wheel units are of the vertical single runner type; they develop about 11,000 h.p. under a head of 30 ft. These wheels operate at 56 r.p.m., driving a 60-cycle, 6,600 v. generator located just above the water-wheel. On the top of the generator rests the thrust deck, supporting the thrust bearing above. The total weight of the rotating parts is about 550,000 lbs. The exciters are of similar design, but have a rating of 1,200 kilowatts. At full load the main units will require 3,700 cubic feet a second, and the exciter units 550 cubic feet a second.

The governor system is operated from a central pumping station situated near the centre of the power house. The pumps are six-stage centrifugal pumps, each capable of delivering 1,100 gals. a minute at 200 lbs. pressure. The pumps are operated by 250 h.p., 2,200 v. induction motors which take their power from the exciter generators. In addition there is a low pressure pumping plant to furnish water for cooling the bearings and also for supplying water in the transformer house for cooling the transformers.

The generators are located on the shaft, immediately above the water-wheels. In order to support the weight of the whole rotating mass, consisting of water-wheels, shaft, and generator rotor, a thrust bearing is provided on the top of the generator. This bearing is carried on a bridge-like structure. In order to hold the shaft steady two guide bearings are provided, one being immediately above the water-wheel near the bottom of the shaft, and one immediately beneath the thrust bearing at the top. The lower bearing is of the lignum vitae type, lubricated with water; the upper bearing is of the standard babbitted type, lubricated from the oil-pressure system.

The location of the thrust bearings at the top of the generator is of considerable importance, and is a somewhat new departure for a plant as large as that at Cedars. By this method it is very accessible for inspection and repairs, and the cost of the whole power house was lessened considerably.

The generators have a capacity of approximately 10,000 h.p. each. They deliver electrical energy in the shape of 3-phase, 60-cycle alternating current, at a normal voltage of 6,600. These generators are exceptional in their dimensions, the diameter of the rotor being 32 ft. The height of the machine is only 2 ft. 9 ins.

The electrical equipment conforms to the usual standard in plants of this description. The main control desk is in a gallery on the west side of the power house, and the control for all the machines is centred on this control desk. The power is taken from the power house to the transformer house, which is situated on the bank of the river about 850 ft. from the power house. In this transformer house are the step-up transformers for raising the voltage for long distance transmission. The switches, both high and low tension, in the transformer house are controlled from the control desk in this building.

Nine main units are now in operation. Measurements have been made of the power output of these machines at full gate, and they have been found to fulfil their specifications.

The transformer house, built of reinforced concrete, consists of four storeys, and is 86 ft. wide by 220 ft. long, and 90 ft. high. The house contains six 8,000 kw. transformers for stepping up the current from 6,600 v. to 110,000 v. for the Messena, N.Y., line, and three transformers of 5,000 kw. each for stepping up the current from 6,600 v. to 66,000 v. for the Montreal line. In addition to those mentioned there is a spare of each kind provided.

In the upper part of the transformer house are located, in duplicate, the high tension bus bars for both the 110,000 and 66,000 volt current. On the first floor are the oil switches and the bus bars for the 6,600 volt power from the power house, and also the usual benchboard and instruments controlling the low and high tension switches in the transformer house.

Setting one of the transformer house columns.

In both the power house and the transformer house every care has been taken to make the structures as fireproof as possible. With the exception of a few doors in some inside partitions, no woodwork is used in either the power house or transformer house, and no combustible material is used in the erection of either building.

In addition to the apparatus referred to, motor generator sets to provide the direct current for the excitation of the fields of the generators have been installed. This auxiliary apparatus is operated by three 1,500 h.p. water-wheels, driving three generators of the same size and providing 60-cycle alternating current at 2,200 v.

The gate house is situated on the upstream side of the substructure of the power house. In this section are installed racks for keeping foreign material out of the water-wheels, and the head gates by which the water can be shut from the water-wheel chambers and repairs to the water-wheels carried out.

Great precautions have been taken against ice. Two spillways have been provided on the south bank, and by opening the gates water and ice can be passed out of the canal into the river; ice passages are also provided through the power house. It is expected that frazil ice, after passing the rocks, will be swept through the water-wheels, the openings being 8 ft. high and 2 ft. wide.

Although work on the plant was commenced in June, 1912, little was done until the following September. Practically the whole of the following year was spent in installing the construction plant, a contract having been made in the spring with Messrs. Fraser, Brace and Company for the whole of the work with the exception of the power house superstructure and the transformer house. In order to facilitate construction and installation, lines were constructed from the site of the development to the Soulanges Canal, half a mile distant, and loaded cars were brought down the canal on barges from Couteau Junction. The material and machinery were then transported over the contractors' lines to the site. By November 1, 1914, the work was completed, and on November 5 the first exciter was turned on. On January 1 all the plant was ready to receive load. The present installation is only intended to develop 100,000 h.p., but it is capable of being extended to bring the total capacity up to 160,000 h.p. The company is supplying 60,000 h.p. to the Aluminium Company of America, and 20,000 h.p. to the Montreal Light, Heat and Power Company.

The executive committee appointed by the Board of Directors consisted of: Mr. Howard Murray, Vice-President; Mr. J. S. Norris, Secretary-Treasurer; Mr. Julian C. Smith, Hydraulic Engineer; and Mr. R. M. Wilson, Electrical Engineer. The direction and control of the construction work was entirely in the hands of this committee. Two other well-known Montreal engineers were connected with the work in a consulting capacity—Mr. Henry Holgate as Consulting Hydraulic Engineer, and Mr. R. S. Kelsch as Consulting Electrical Engineer.

The general contract was carried out by Fraser, Brace and Company, Montreal, the superstructure of the power house and the transformer house being erected by the Unit Construction Company. The other contracts were:—six 10,000 h.p. and three 1,500 h.p. water-wheels, I. P. Morris, Philadelphia; three 10,000 h.p. water-wheels, Wellman, Seaver, Morgan Company, Cleveland; governors and governor pumps, I. P. Morris; generators, exciters, low tension switching, and switchboards, General Electric Company, Schenectady; lubrication, Petersen Engineering Company, Milwaukee; head gates, Structural Steel Company, Montreal; racks and steel superstructure, Phoenix Bridge Company; gate hoists and cranes, Whiting Foundry Company, Harvey, Ill.; auxiliary transformers, Canadian Westinghouse Company, Hamilton, Ont.; dredging, Simpson Bros., Montreal.

Power house under construction—view from the south.

The contractors' equipment, which included the following, will give a good idea of the extent of the job:—Shovels—four 70-ton Bucyrus, three Model 60 and one Model 75 Marion; engines—fourteen 25-ton Montreal Locomotive Works, five 25-ton and one 18-ton Porter, two 18-ton, three 25-ton, and one 35-ton

Vulcan; gyratory crushers—one No. 6 McCully, one No. 5 Symons, two No. 5 and one No. 7½ Traylor; pulverizers—one Williams and one Kennedy; one Hunt automatic coal railway; dump cars—160 K & J 6 yard, seven Continental 6 yard, 36 Western 12 yard; one Western spreader car; eight standard gauge flat cars; four 200 h.p. Canadian Ingersoll-Rand air compressors; forty Canadian Ingersoll-Rand rock drills; eleven 10-ton Terry & Tench stiff-leg derricks; twelve Beatty hoisting engines; six Beatty centrifugal pumps; three Lawrence Pump and Engine Company's direct connected motor-driven pumps; one Brownhoist 10-ton locomotive crane; one McMyler 5-ton locomotive crane; eight Mead-Morrison swinging engines; one Lidgerwood-Crawford dragline excavator of 50 ft. radius; mixers—five 40-ft. chain belt concrete, two 40-ft. Smith concrete, one 40-ft. Ransome concrete, one 25-ft. Smith concrete, and one Ransome grout; four Hayward "orange-peel" buckets; three Beatty clamshell buckets; sixteen Schell concrete cars; bottom dump concrete buckets—four Insley, 16 Steubner, 4 Acme; 1 Leyner drill sharpener; one dump cableway, 1,800 ft. span, supplied by the United States Steel Products Company; dynamite—Canadian Explosives Company; cement—Canada Cement Company; electrical equipment, motors, etc.—Canadian General Electric, Allis-Chalmers, Bruce Peebles, and Wagner Companies.

Defining the Nature of Asphaltic Concrete

COMMENTING on the lack of definiteness in the meaning of this term, and the desirability of limiting the character of mixtures to which it is applied, the Municipal Journal notes that asphaltic concrete is coming into a degree of popularity that makes it highly desirable to identify this form of pavement by more definite standards than now exist. Asphaltic concrete in one city may mean a sheet asphalt surface mixture with the addition of 8 per cent. of 2-mesh and less than 20 per cent. of 4-mesh stone. In another city the mixture may be a rough-and-ready combination of 40 per cent. of sand and 60 per cent. of stone. One of the more carefully prepared specifications contains the following provisions:

> Sand: The sand shall be a natural bank or river sand, all of which will pass a 10-mesh screen. On sifting, at least 15 per cent. shall be retained on a 30-mesh screen, and at least 22 per cent. shall pass an 80-mesh and be retained on a 200-mesh screen.
>
> Stone: The crushed trap rock shall all pass a screen of 2 meshes to the lineal inch and all be retained on a 10-mesh screen, or a run of crusher trap rock can be used provided the portion passing the 10-mesh screen is of suitable grading to serve as sand and filler, in which event only sufficient sand and filler will be added to insure the proper proportion of sand and filler in the mineral aggregate.
>
> Filler: If the screenings do not contain sufficient 200-mesh particles, they shall be supplied by the addition of a suitable amount of ground limestone, or any other mineral matter (or Portland cement) of sufficient density to produce a powder having a volume weight when ultimately compacted of at least 90 pounds to the cubic foot. It shall be so fine that at least 75 per cent. shall pass a 200-mesh screen.
>
> Combining Materials: The sand and rock complying with the above specifications shall be combined in such proportion that the finished mixture shall contain not more than from 8 to 22 per cent. of aggregate passing a 4-mesh and retained on a 10-mesh screen and less than 10 per cent. passing a 2-mesh and retained on a 4-mesh screen.

An aggregate such as that described in this specification might be more correctly denominated a stone-filled asphalt mixture rather than asphaltic concrete. The name, of course, is not important so long as we know what it means; but when a pavement is described as asphaltic concrete the term ought to convey something definite to the mind. This cannot be the case so long as a mixture such as that just described is called asphaltic concrete by one engineer while another applies the same term to a mixture consisting of ½ to 1¼ inch stone and from 10 to 15 per cent. of sand of an unspecified grading. We should at least distinguish between "fine asphaltic concrete" (meaning a standard sheet asphalt surface mixture with the addition of fine stone) and "asphaltic concrete" of the type that is perhaps more exactly described as asphalt macadam, the former being a stone-filled sheet asphalt mixture, and the latter a stone mixture to which there is added a small proportion of sand.

About the oldest examples that can be found of asphaltic concrete that has been laid in any considerable quantity are in Buffalo and Rochester, N.Y. This type of pavement has been used in these cities for more than ten years. As described by the contractors, who have laid a large yardage in Rochester, the mixture is of the following composition:

Composition.	Original mixture.	Finer portion.
Bitumen	8.9	11.1
200-mesh	12.3	17.1
100 and 80-mesh	10.8	15.0
50 and 40-mesh	24.2	33.7
30, 20 and 10-mesh	16.3	22.7
4-mesh	21.5	....
2-mesh	5.4	....
	99.4	99.6

It will be observed that this mixture contains a considerable proportion of 200-mesh material, and comes within the definition "fine asphaltic concrete." So also does the mixture laid in Riverside Drive, New York, in 1913. The latter pavement has given an excellent account of itself so far under very trying conditions of traffic. It is not to be assumed,, however, that asphaltic concrete, consisting of haphazard stone and sand combinations, and without a sufficient amount of fine material, will give the service that can be obtained from the mixtures more properly described as stone-filled sheet asphalt.

For some years the composition of asphaltic concrete mixtures was governed more or less by the terms of the decision of Judge Pollock, out of which developed the so-called Topeka specification. The Topeka decision, however, did not assume scientifically to determine what would be an ideal paving mixture, but merely held that a certain mixture would not constitute infringement of a patent. It lies with those who are interested in the building of good pavements to see not merely that a patent is not infringed, but that a good paving mixture is obtained. The term "standard sheet asphalt paving mixture" now conveys a definite meaning. It is important that the term "asphaltic concrete" should have an equally definite meaning.

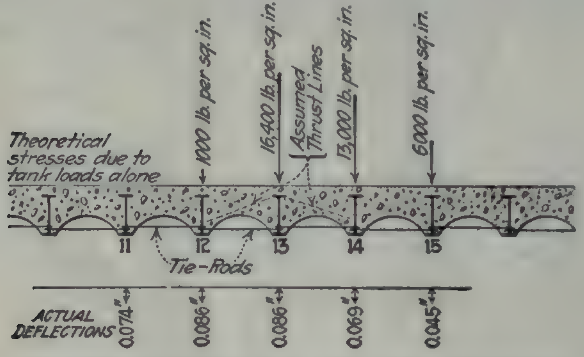
A Test of the Load-Distributing Action of Floor Arches

By Frank N. Kneas*

An unusual test was made recently under the writer's direction—measuring the deflections the probable amount of stress in certain of several steel beams in a floor to discover beams. Some of the beams in this floor were to have concentrated loads placed on them, while adjacent beams were to be be practically unloaded; a change had evidently been made in the loading of the floor from that considered in the original design. The floor under the new conditions was to carry horizontal cylindrical tanks resting in cradles supported on pedestals, some of which would come directly over a beam. The question was, would the floor arches act in such a manner as to transfer some of the load from the high-stressed beams to the adjacent low-stressed beams?

The subjoined sketch shows a cross-section through the floor—20-in. 65-lb. I-beams spaced 38 ins. on centres and spanning 22 ft.; reinforced-concrete arches between the beams with rise of 10 ins., top of concrete about 4 ins. above the beams, and arch about 14 ins. thick at the crown.

Disregarding the bridging action of the concrete, the theoretical stresses due to the pedestal loads only ran up to 16,000 lbs. to a sq. in. for certain beams, while adjacent beams were apparently stressed as low as 1,000 lbs. to a sq. in. In one case the theoretical deflection at the centre was ⅜ in. for one beam and only 1/40 in. for the next beam. It seemed impossible that this could occur; more likely the concrete would "drag" the adjacent beams down with the heavily stressed beams, and thus reduce the stresses in the latter.



Floor tested for distributing action under heavy concentrations.

To get definite information on this distributing action, it was arranged to measure the actual deflections. Instruments were erected under about 12 beams, as well as under the girders on which the beams rested; the instruments multiplied the deflections by 20, so that it was possible to get very accurate measurements. The loading of the floor was very simple—it consisted of filling the tanks with water. The tanks were emptied after 48 hours to determine the amount of deflection that the beams would recover.

Inasmuch as the beams were spliced over their girders and the concrete around the top flanges of the beams acted as part of a T-beam, the actual deflections were much less than the figured deflections. Of course, the deflections for the dead-load were already in the beams before the tanks were filled, so that the deflections actually read were for the water loads only. Consideration was given to the deflections in the girders on which the beams rested, corrections being made in all deflections of the beams due to the deflection of the girders. But the corrected comparative deflections of the beams proved very interesting, and are shown in the sketch.

Although the theoretical stresses in the beams (the concrete not being counted as part of the section) differed so greatly, yet the deflections were very uniform. It is evident that a considerable portion of the load was taken through thrust lines similar to those dotted on the sketch to adjacent beams, and that thereby the load was distributed almost equally over the five numbered beams.

The test is interesting not only in showing the distributing action of such deep arches on such close spacing, but also as indicating that in more regular floor systems, such as terra-cotta arches between steel beams, there may be similar action tending to distribute heavy loads (such as partition loads) from one beam to adjacent lightly loaded beams.

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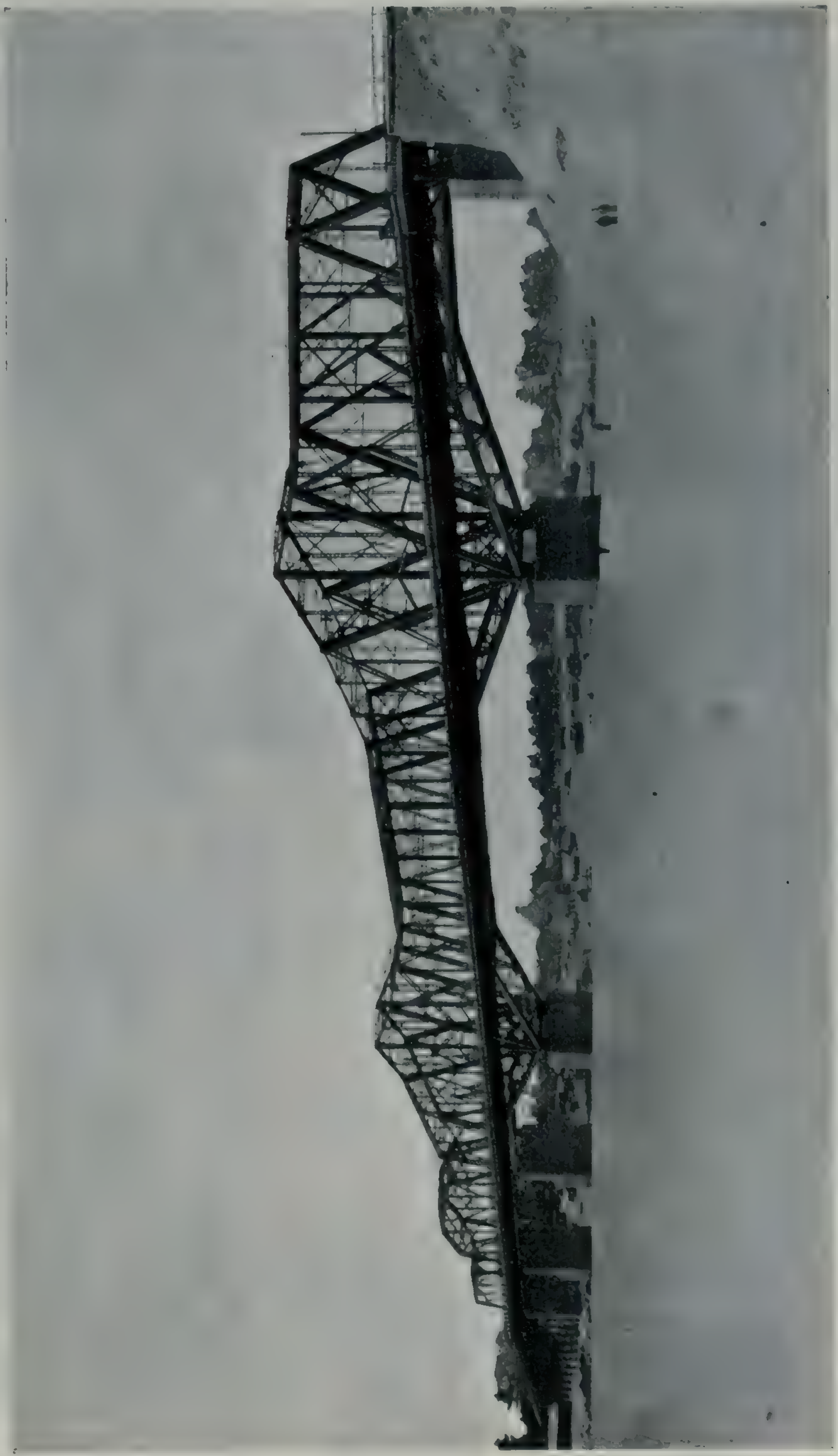
* Writing in the Engineering News.

The Alexandra Interprovincial Bridge, Ottawa

The Interprovincial bridge across the Ottawa River was built in 1900, and was formally opened by King George the Fifth, then Duke of York. It received the name of the Alexandra Bridge, and, as the term "Interprovincial" implies, it connects the provinces of Ontario and Quebec. The bridge carries a single steam railway track and two electric railway tracks, besides two roadways and two footpaths. The railway track and the two footpaths are between the trusses, and the two electric railways are carried immediately outside the trusses. The carriageways are outside of the electric lines. Including the approaches, the total length of the crossing is 2,684 ft. 9 ins., and of this the bridge proper makes up 1,495 ft. 9 ins. This figure includes 1,049 ft. 9 ins. of cantilever structure, two truss spans of 247 ft. and 140 ft., respectively, and two short girder spans at the Ottawa end totalling 59 ft. The weight of the entire structure is 3,809 tons.

The erection of this bridge presented some unusually difficult features, due largely to ice conditions. Unavoidable delay in starting, coupled with unexpected trouble from frazil ice, compelled a change from the original erection scheme. The 140-ft. span was built on ordinary falsework between December 20th, 1899, and January 3rd, 1900, and upon it the traveller was immediately constructed. The 247-ft. span was then begun, using floating falsework. A Howe truss carried on four specially built scows supported in its turn bents of timber framing designed to act as falsework for each of the three 247-ft. spans, the two anchor arms, and the simple span. The floating falsework was placed ready for the 247-ft. simple span early in January, 1900, and by the 30th of the month the span was complete—that is to say, without the brackets, which were placed on all spans later in the erection.

The great trouble with the ice was now experienced, when it was hoped to be able to move the scows and falsework to the next opening, but it was February 23rd before they reached the desired position. The depth and consistency of the "frazil," together with the speed with which it rose and filled all the space



The Alexandra Bridge from the Ottawa shore.

Erecting Hull cantilever.

Erecting Ottawa cantilever.

Veiw from the Ottawa shore.

Floating steel across the river.

cut in the solid ice, combined to make the operation arduous and expensive, and it was decided to erect the lower chord, lower web members and floor system of this Hull side anchor arm clear of their true position, and then float them over to the Ottawa anchor arm opening, completing the erection of the Ottawa anchor span. The break-up of the river ice came late in 1900, and it was April 19th before the assembled steel could be moved across. The falsework was taken downstream, turned end for end, and towed upstream to its new position. The erection was then continued, and this span reached its final position complete and on the masonry on May 29th. The cantilevering from the Ottawa side was immediately proceeded with, and the centre of the suspended span reached by July 10th. On June 2nd the floating falsework was moved back to the Hull side anchor span, and this steel was erected when the traveller had been transferred by derrick scow from the Ottawa cantilever. The Hull cantilever was commenced on August 30th, and the last pin driven on October 7th, 1900.

The scows used in this work were launched at Lachine and towed up to the site of the bridge, carrying the timber for the falsework, trusses and bents, and all blocking, tackles, derricks, and other equipment. The four used in the floating falsework were each designed to carry 225 tons, consisting of the steelwork built over them, the traveller, blocking, falsework, etc.

The structure was fabricated and erected by the Dominion Bridge Company, of Lachine, Que.

Artificial Illumination in Relation to Architectural Effects[*]

By S. D. Chalmers, M.A.[†]

THE great progress in the theory and practice of artificial illumination has provided architects with new materials and resources for producing architectural effects, particularly in relation to the interiors of buildings and the decoration of halls and smaller rooms. It is true that the illuminating engineer has as yet made little progress in the application of his new methods to these purely architectural problems; it was only natural that he should first turn his attention to the more utilitarian aspects of artificial lighting; his aim has been to produce the illumination requisite for the comfortable use of a room for its ordinary purposes; and economy has been one of his prime considerations. He has, to a very considerable extent, solved the problem of the efficient and economical distribution of the light available. He avoids excessive illumination of any point, and by screening his sources of light reduces the glare, and so is able to obtain the same visual effects with reduced actual illumination. He takes into account the reflection co-efficient of his walls and ceilings, the nature of the objects to be illuminated, and the fineness of detail which must be distinguishable. Incidentally he has made some progress in the illumination of the architectural features and decorations of the rooms. But progress in this latter direction is more dependent on the architect than on the illuminating engineer. It is not always possible to make effective use of artificial light in buildings and rooms which have been designed entirely with a view to their effect in daylight. Just as the architect considers the site and lighting of his building in regard to its outside form and its interior decoration, so he should consider the scheme of interior decorations in relation to the artificial lightings with which it will be used. Some types of decoration are quite unsuitable for artificial illumination and should be avoided in rooms which are intended to be used almost exclusiely in artificial light. Other types are suitable for either illuminant. But the differences between the characteristics of daylight and artificial illumination are such that one cannot assume that good results will be obtained by artificial light, even though the results by daylight are most satisfactory.

But under the term of artificial illumination we include such varieties of actual lighting that much may be done to improve the effect in any given case.

It is my object to point out the fundamental similarities between natural and artificial lighting, to indicate how variations in natural lighting have led to important architectural developments, and to show how the results achieved with natural lighting may indicate the successful treatment with artificial lighting.

The great contrast between the Classic and Gothic styles is closely associated with the variation of the lighting conditions. In Greece the conditions were simple --a bright source of light almost always available, and a relatively small amount of diffused light. In the sunlight clear-cut shadows were produced, and only shallow mouldings were necessary to secure the necessary contrasts of light and shade. This is well illustrated in the columns of the Parthenon, where the sharply undercut mouldings produce clear sharp bands of shadow. But when buildings in the Classic style are erected in climates like our own the quality of the light is different, and the features must be modified if the same effect is to be produced; and the proportion of diffused light being greater, it is necessary to deepen the flutings to produce sufficient contrast. This same general characteristic is noticeable in artificial illumination when one bright source is replaced by a number of small ones.

It is this same effect of deeper mouldings and flutings that marks the Gothic as contrasted with the Classic architecture, and once more it is the lighting conditions which determine the extent of the change; the more diffused the light, the deeper must be the moulding. Another case of adaptation to the lighting is the pulvinated frieze, in which the surface is lightly curved, so that the upper part intercepts more light than it otherwise would do, and so gives a shading from the bright upper to the dull lower part. This is effective in the case where the light is well diffused, but comes only from a comparatively restricted sky area. This is an intermediate case between the direct sunlight and the wholly diffused light.

These same general principles apply also to interior ornament. The more diffuse and less direct the lighting, the more is it necessary to intensify the mouldings, carvings and other relief. When the lighting comes from above in a comparatively narrow beam, the ornament must be in low relief, while a general diffused lighting from in front is more suitable for cases of deeper relief. An illustration of this principle is furnished by the Miserare seats, with the low relief above and deep relief below. In most cases of artificial lighting, ornaments on the level of the lights may be in deeper relief than those well above or below. In the same way it is unwise to illuminate a ceiling with deep moudings by lights placed too close to the ceiling, as this results in long and deep shadows. When the lighting is very diffuse, it is sometimes preferable to produce the impression of depth by special devices, such as the linen-fold panel of the English and Flemish architecture of the fifteenth century. Such devices are usually suitable for artificial as well as natural lighting.

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[*] Paper before the Society of Architects.

[†] Head of the Department of Technical Optics, Northampton Institute, England.

Artificial Lighting of Interiors

Turning now to the possibilities of the artificial illumination of interiors, we find that the conditions are in some respects less, and in others more, favourable than those of natural lighting. The daylight usually comes as diffused light from a comparatively large window area, producing very variable illumination throughout the room. It is exceedingly difficult to modify its distribution to any appreciable extent, and the amount is very variable throughout the day and year. On the other hand, the eye adapts itself very readily to the variations of daylight, ignoring all excessive contrast and accepting the variations in colour of the light without noticing them. Not the smallest advantage, perhaps, is that the actual source of light does not come into view, and we are not obliged to devise special methods of screening it.

In the case of artificial illumination the original sources are comparatively small bright objects which obtrude themselves most unpleasantly if we omit to screen them from direct view. But because the sources are small we can surround them by diffusing screens or reflectors, and materially modify the distribution of the light coming from each source. With modern, properly designed reflectors it is possible to produce almost any desired distribution of the light, from practical uniformity to concentration in comparatively small angles in any desired direction. By the judicious placing of the sources of light and the proper choice of reflectors we can obtain almost any desired distribution of the light with one limitation, that the light coming from each individual source to any point will be coming in a comparatively small angle. Each source would tend to produce well marked deep shadows, and care must be taken that the effects of the other sources are to reduce the depth and size of these shadows to the desired amount. In this way the shadows may be made architecturally useful rather than the reverse.

It is this possibility of varying the character of the lighting and the change in the distribution almost at will that makes it possible to obtain different architectural effects. The ideal of the illuminating engineer has generally been to produce even and soft illumination throughout the room. But it seems to me that this is not always the most suitable lighting, and that in some cases a more one-sided lighting, with a subsidiary cross or reverse lighting, might be usefully employed. In using this method one must not attempt to imitate the conditions of daylight too closely. The variations must be considerably less than those of daylight, because the actual illumination will usually be considerably below that which prevails with daylight, and at this lower illumination the variation is much more readily appreciated. This effect is not materially altered by actually increasing the illumination by artificial light, because of the dazzling effect of intense artificial light. Owing to the adaptation of the eye to the conditions prevailing in artificial illumination, comparatively small variations are effective, and it is unwise to produce strong contrasts between the different parts of the room. Most people find it unpleasant to sit in a well-lighted part of a room while the rest is in comparative darkness. It is on account of this adapt condition of the eye that it is so important to screen the modern sources of high intrinsic brilliancy, and the only effective way is to make the light appear to come from an area much larger than that of the source. The smallness of the size of artificial sources is troublesome when reflecting surfaces, such as varnished wood, are present, and in some cases the reflections are objectionable. They may be reduced by increasing the size of the source or altering its position. The same difficulty of reflection occurs in connection with picture lighting, and care should always be taken to place the sources sufficiently above the picture to make the reflection invisible at the ordinary level of the eye. This generally adds to the difficulty of securing even illumination on the picture, but by properly distributing the light from the source almost any required degree of evenness of illumination can be obtained.

Still further difficulties are encountered in regard to coloured ornamentation, and these troubles are accentuated if the illumination on the coloured object is low. The relative brightness of the parts of different colours will change as the illumination is diminished, and it is a wise precaution to secure abundance of light for any coloured ornamentation. Even with this precaution the colour values are unlikely to be exactly the same as with daylight, though the recent attempts to improve the colour rendering by artificial light have met with considerable success. But the rendering of variations of shade in a flat object is almost the same by artificial light as by daylight, and the same may be said of pierced work where the contrast of a carving is enhanced by piercing.

Pierced screens are interesting, as showing one of the earliest methods of combining natural with artificial lighting effects. In daylight the screen is lit from in front, the openings appearing dark to contrast with the screen; when the altar is lit up the screen is seen in silhouette, and the piercings are light. The same effect of interchange of light and dark in natural and artificial lighting is seen in the windows of churches and other buildings. The walls near the windows, which are of least importance in daylight, are the most prominent features in the artificial light. Their architectural treatment, though making little difference by daylight, may be of the geratest value for artificial lighting.

Diffused Lighting

But there are other methods of artificial lighting to which I would like to refer. In these methods attempts have been made to imitate the conditions of daylight lighting. An example is the use of a group of lights surrounded by large diffusing screens or reflectors, in imitation of the method of the oculus as used in the lighting of the Pantheon. It is easy in special cases to imitate the effect of this method of daylight lighting, and the method is applicable in large halls or theatres. But the method of indirect lighting approaches most directly to the effects of daylight.

In this method the light from the source is sent on to a white ceiling or screen and is directed downwards to illuminate the room. The absence of marked shadows renders this method useful for certain purposes, as, for example, the lighting of drawing offices, but unless the illumination is very high the method gives the impression of a poor imitation of daylight, suggesting coldness and winteriness. We interpret this artificial lighting, in terms of daylight and the suggestions that this daylight carries with it.

It is probably on this account that many people prefer the semi-indirect system of lighting, in which part of the light from the source is allowed to pass through the shade, while the other part illuminates the ceiling. In this case the impression of artificial lighting is retained and the camparison with daylight does not obtrude itself; at the same time the conditions of shadow are more those of daylight, and the indirect light from the ceiling tends to soften the whole lighting. This method of semi-indirect lighting is specially useful when the ceiling and frieze are worthy of attention in themselves, as, for example, in beautiful moulded ceilings.

In all these cases of indirect lighting it seems preferable to show sources which illuminate the ceiling even if the greater part of the light be really derived from concealed sources. There, are however, a number of cases where the ceiling has been lit entirely by means of concealed lights, and the effect has not been happy. These lights produce beautifully even lighting on the ceiling, but one unconsciously asks where does the light come from, and the only explanation is that there must be an opening between the walls and the ceiling, and apparently it must extend all round, there being no distinctive direction in which the light comes, and ceilings which are unsupported are uncanny. In one of these cases the effect was much improved by the use of a number of visible sources which apparently illuminate the ceiling. Thus, as regards interior illumination, the conditions are somewhat different for artificial and natural lighting. But each has its advantages, and by judiciously using the resources of artificial lighting it should be possible to obtain quite as good results as with natural lighting, but this is a matter for the architect as well as the illuminating engineer. New methods and arrangements of lighting are required.

In the cases where rooms are to be used only or mainly by artificial light, the architectural features should be designed in relation to the actual method of lighting to be employed. When few but large sources of light are to be used, the conditions approximate to outside natural illumination, and models of ornament and architecture may well be sought in Classical types; but when numerous smaller sources are to be used, the conditions approximate more to the Gothic conditions, and mouldings and ornamentation of this style might well be studied in connection with their value in artificial light.

Exterior Lighting of Buildings

Another interesting problem which I can only touch on lightly is the illumination of the exterior architectural features of a building. When the aspect is a southern one, the same conditions as in daylight may be approximated to by the use of one large source of light high up in front of the building, and a number of smaller sources placed lower down and distributed along the length of the building. When the aspect is a northerly one, the whole lighting should be by a number of small sources evenly distributed in front of the whole building. Occasionally friezes can be well lit by concealed lights above the frieze, the proper distribution of the light being secured by the use of suitably designed reflectors. In this case, again, the difference between the treatment of high and low relief is important, and the effect of the high relief is even more exaggerated for statues or very deep mouldings, which require front rather than high lighting.

The Position of the Engineer

THE following is part of an address delivered by Mr. Ira O. Baker, Professor of Civil Engineering in the University of Illinois, before a recent convention of civil engineers. It is reprinted from the Engineering News.

I am persuaded that the chief reason that the engineer does not attain to the position in the public estimation which he might occupy is because of wrong ideals. The representative engineer magnifies the importance of technical matters; in college he is insistent upon acquiring a so-called practical education—that is, he desires to specialize and to take only the subjects immediately connected with his chosen profession. As a consequence, he lacks breadth of view and is weak in knowledge of non-professional matters. Too often he has sought to perfect himself in technical details to the neglect of a knowledge of political procedure, of business methods, of labor conditions, or of social problems. Further, he is often seriously deficient in the ability to use correct language.

What, then, can the young engineer do to prepare himself for a wider usefulness and a larger success? I have several definite suggestions:

> By continual care and practice, cultivate the ability to express yourself in writing and in speaking in clear, concise, correct English. There is nothing more necessary to the young engineer who desires to attain more than a mediocre success.
>
> Extend your horizon by reading and by the study of industrial and political history, political and social science, economics, labor problems, and other vital subjects.
>
> Do not become a man of technical details nor a man of books to the exclusion of a knowledge of affairs. The successful engineer must buy materials; therefore he must have a knowledge of market conditions and of business methods. A successful engineer directs the labors of others; therefore he must know much of the motives that influence men, and must understand the point of view of organized labor, and should have at least some knowledge of the advantages and disadvantages of the different methods of payment. An engineer is frequently called upon to report upon projects; therefore he should be able to foresee all the industrial, commercial and financial conditions involved in the project, and should be able to accurately discriminate as to the relative importance of the various conflicting factors. The engineer writes specifications and makes contracts; therefore he should know something of the intricacies of the law.

Comparative building statistics of the city of Montreal just issued are as follows: 282 permits were issued in May, 1915, as against 716 in May, 1914. The value of the permits issued in May, 1914, was $2,517,148, against $529,167 for May, 1915. From January 1 to May 31, 1914, 1,823 permits of a total value of $6,578,314 were issued, and in the same period of 1915 948 permits were issued, of a value of $2,517,994.

A Modern British Columbia Fish Curing and Packing Plant

Concrete Floors Used for Cleanliness—Successful Insulation of Cold Storage Rooms

At Steveston, B. C., at the mouth of the Fraser River, a cold storage plant has been completed recently for the B. C. Packers' Association. It is one of the largest fish curing and packing plants yet erected in British Columbia. The buildings and dock cover an area of 250 ft. by 400 ft., and there is sufficient depth of water at the outer end of the dock to permit boats to land their cargoes of fish at all stages of the tide.

The main cold storage building is three storeys high, 105 ft. in width, and 125 ft. in length. This building is devoted entirely to frozen fish. There is also a side building refrigerated for the storage of mild cure salmon; this structure is 55 ft. wide and 125 ft. long, and two storeys in height.

With reference to the construction of the different cold storage buildings, an insulation consisting of a combination of air space, planer shavings and linofelt has been used with great success. This applies to all parts of the buildings, with the exception of the main floors, which are waterproof, and have a 4-in. insulation of cork in addition to the shavings and linofelt. This insulation has given such good results that this refrigerated space, having a volume of 550,000 cubic feet, can be kept at a temperature varying from 20 degrees below zero to 10 degrees above zero, with the use of one 30-ton refrigerating machine.

The fish shed on the dock is constructed with a concrete floor, this being for the purpose of cleanliness. The concrete floor extends over the entire area of the fish shed, which is 90 ft. x 125 ft. The cement finish is brought up around the walls and columns to a height of 2 ft., and the floor is also provided with a number of drains. In order to handle large quantities of fish, it sometimes happens that 100,000 lbs. or 150,000 lbs. are dumped at one time on this floor, and should the plant be busy at the time the fish can be mixed with ice and kept in perfect condition for twenty-four hours or more, and in this way the capacity of the plant is increased.

Exterior of Columbia cold storage plant.

The box-making department is situated above the fish shed, and has the same area. Here all the material used to manufacture boxes is stored, and also a great number of boxes made up and stencilled ready for use at any time. Shipments of fresh fish can be taken from steamers and loaded in cars on the company's side track in a very short time, as it is possible to pack the fish in ice, place them in the car, and ice the car at the same time from a platform above. If necessary, a shipment of 300,000 lbs. of halibut or salmon can be boxed, iced and placed aboard the cars in six hours.

Interior of a cold storage room.

The mechanical equipment of the plant is situated on the side next to the land, and comprises: 1 coal bunker with a capacity of 600 tons, 1 boiler room, 1 engine room, 1 room for auxiliaries, 1 room for ice tank, and 1 room for condensers, besides a space left for the office.

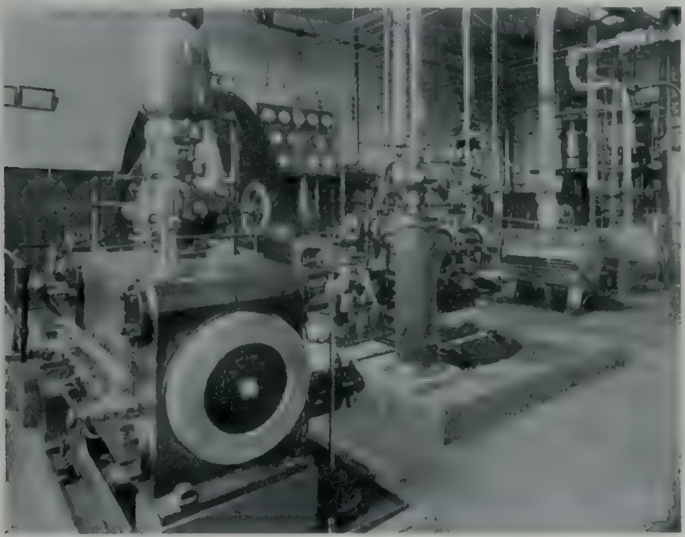
The main cold storage building is divided into storage rooms, work rooms and "sharp freezers." There are seven "sharp freezers," which have a capacity of 40,000 lbs. each, and here the freezing is done. The temperatures of these rooms are kept at about 20 degrees below zero, and the fish remain in these rooms until frozen entirely through. The freezing is accomplished by direct expansion pipes, and also by air blast. The freezers are equipped with a Sirocco fan, which displaces 25,000 cubic feet of air a minute. This cold air is kept in circulation, purified and washed, at the rate of 25,000 cubic feet a minute. After the fish have been frozen thoroughly they are removed to the glazing and packing departments, where they are dipped in fresh water and given a coating of ice. They are then wrapped in paper and placed in boxes to be stored in the rooms above until the time of shipment. The total capacity of the building for frozen fish is 7,500,000 lbs., and the capacity for mild cure salmon is about 1,200,000 lbs. The entire cold storage space is refrigerated by the direct expansion system, and for this purpose about 75,000 lineal feet of pipes are installed in the various rooms.

The coal bunker is situated adjacent to the boiler room; it has a capacity of 800 tons of coal, and is equipped with one steam hoist and derrick for transfering the coal from the scows to the bunker. Below the coal bunker are placed three tanks for the storage of fresh water; these tanks contain 36,000 gallons, which is a sufficient quantity to last the plant for ten days in case injury should happen to the city water mains.

The boiler room is equipped with two 150-h.p. return tubular boilers, and these are fitted with Jones underfeed stokers. One Weir boiler feed pump is supplied, together with a 400-h.p. Ideal heater and purifier. By using the heater and purifier the temperature of the water delivered to the boilers is at all times 210 or 212 degrees.

The engine room is equipped with three ammonia compressors of different sizes—1 60-ton horizontal, 1 40-ton horizontal, and 1 30-ton upright. This quantity of refrigeration is found to be quite sufficient for all the needs of the plant. The engine room is also equipped with two 25-kilowatt generator units for light and power, and also one small generator unit which supplies current for the elevators. One noteworthy feature is the placing of the elevator hoisting machine on the floor of the engine room, thus giving the engineer an opportunity to take care of it.

The ice tank is capable of manufacturing 18 tons of ice a day, and is situated over a section of the engine room, so that when the product is harvested the blocks can be sent by gravity in any direction to be used. This ice tank is equipped with an automatic air hoisting arrangement and a Curtis air compressor. The condensers are of a capacity of 200 tons refrigeration, and are situated above the ice tank. Water from the river is used, which at times is very brackish. The pumping is performed by a Weir service pump, size 9 x 18. Further pumping units are installed for emergency, and cross-connected to the pipe system of the plant.



Power house and refrigerating machinery.

The entire work was designed, and construction supervised, by the Linde Canadian Refrigeration Company, Limited, of 37 St. Peter Street, Montreal, Que., and this firm also carried out the contract for the supply and installation of the refrigeration machinery.

The destructive effect of heavy wagon loads carried on narrow tyres, and its seriousness in connection with the upkeep of the roads, is called attention to by the State Highway Commission of Colorado in its recent biennial report. It is also pointed out that any method leading to the adoption of a law for a maximum load per inch of tyre, not to exceed say, 500 lbs., would result in a large saving in maintenance. The report contains a number of pages devoted to the width of tyres, and contains the practice of various States and foreign countries. It also includes comments on the subject by well-known authorities, covering a range of years.

The Use of Large Stone Chips in the Maintenance of Bituminous Roads

THE Maryland Highway Commission, of which Henry G. Shirley is Chief Engineer, after an experience with the maintenance of bituminous roads extending over several years, has adopted the practice of using stone chips at least one inch in size. The chips are spread over the surface of the road, at seasons of the year when the bitumen is soft, in an even layer one stone thick, and rolled. The rolling forces the stones into the surface of the road until they are flush with the pavement. When completed the surface has somewhat the appearance of a mosaic. Hard blue limestone is used, and has been found to be quite satisfactory for this purpose.

The reason for the method of maintenance adopted is obvious. It has been universally found in practice that small stone chips are either quickly ground to a powder by iron-shod traffic or are in a large measure swept from the road surface by automobile traffic. The use of sand is now quite generally avoided by maintenance engineers, on the ground that it tends to build a mat or pad that becomes unmanageable when thick, and also greatly increases the danger of waves in the pavement due to the pushing of the bituminous surface occasioned by the continual passage of automobiles, usually travelling in a single direction on one side of the road.

While this method of surface maintenance—or, more properly, surface improvement—is not new from an experimental standpoint—similar work having been done by Major Crosby, the former Engineer for the Commission—its application to road maintenance work on a large scale such as is in progress in Maryland is an innovation. From the standpoint of the road user it possesses advantages. The exposed stones roughen the surface and reduce the slipperiness of the pavement. Slipperiness has always been a fault of bituminous treated country roads, especially since many of the horses that travel them are not sharp shod. The danger of automobiles skidding is also reduced. From the standpoint of increasing the life of the road the reduction in slipperiness permits the use of a relatively higher crown, thereby insuring thorough drainage of the surface and increasing the durability of the road, the practice of most road engineers being to use as much crown as limiting conditions will permit. In this connection it may be said that experience has demonstrated in the city of Washington that asphalt streets and roads built with a high crown have usually a longer life than those streets or roads on which less crown is used.

While the labor cost of applying large stone chips in this manner is necessarily increased somewhat, the road surface is improved by the thorough ironing out it is given by the roller. The greater availability of the supply of larger stone is also a factor worthy of consideration in many sections of the country. It is frequently difficult to secure an adequate supply of ½-in. and ¾-in. stone.

It is believed that the incorporation of large stone chips into the surface of the road is worthy of the consideration of engineers engaged in both maintenance and construction work. While difficulties are encountered, and careful workmanship is required, the results obtained are of sufficient value to warrant the additional cost.—Engineering and Contracting.

Methods and Costs of Plaster Lining of Irrigation Canals

By Calvin Casteel

THE following information dealing with the methods and cost of plaster lining on the Okanogan Project of the U. S. Reclamation Service at Okanogan, Wash., is contained in a paper in the Proceedings of the Washington Irrigation Institute.

This paper will only take into consideration the methods, cost and efficiency of plaster lining, such as has been done on the Okanogan Project. This lining for the most part has been put in the canals and laterals already constructed, and is one and a half inches thick. Practically all concrete has been mixed with a gasoline power concrete mixer.

Design of Cross Sections

The cross section of the concrete lining should be as near an ideal economic section as it is possible to make for new ditches, taking into account the cost of laying as well as the cost of the material. For ditches already constructed, with less than a 3-ft. base and 3 ft. in depth, an economic section can be designed by lowering the grade and backfilling on the sides without making the cost excessive; but if the water surface is fixed, as is generally the case upon ditches that have been constructed and in operation, it may be necessary to raise the sub-grade, which will make the backfill excessive and the cost per lineal foot more than for a section of wider base.

In practice it is not economical to build an economic section in small ditches, as the cost of preparing the base and laying the concrete will increase the cost out of proportion to the saving that is made in the amount of material used, as the bottom width is made too narrow to work in to advantage. This applies particularly to ditches having a depth of between 1 and 2 feet.

For all ditches over 1 ft. in depth it is not economical to plaster them without working in the bottom, and with the bottom width made so narrow that the plasterer can neither stand nor kneel without danger of tearing down the side slopes when he moves, and thereby causing extra work to fix them up as the plastering is done, which will increase the cost to a great extent either by additional help necessary or by delaying the concrete mixer and the balance of the crew.

The side slopes for plaster lining should not be steeper than 1½ to 1. A steeper slope requires the concrete to be mixed too dry to spread easily and to obtain an impervious finish without extra labor, and whenever the concrete is mixed a little too wet it will naturally run if laid on a steeper slope.

A berm not less than 4 ins. wide should be used on small laterals up to a depth of from 1 to 2 ft.; for greater depths this berm should be increased to 5 or 6 ins., and for side hills should not be less than 6 ins. for any size lateral, and may often need to be wider.

This berm not only serves to strengthen the top of the lining, but also prevents surface water from getting under the lining, when it is properly covered with earth after being laid. Ordinarily no harm would come from allowing any surface water to get behind or under the lining, but in the latter part of the winter such as we have at Okanogan, when the snow is going off, it may thaw very rapidly for one or more days and then freeze very hard, in which case, if the water is allowed to get under the lining, heaving will take place and considerable harm may be done.

When a ditch is all in a fill a minimum berm of 4 ins. may be used with safety, but along side-hills where there is considerable drainage into the canal a wider berm should be used; then after it is laid it should be well covered with earth. Where the water has been flowing into the canal in well-defined drainage channels, these should be taken care of by allowing the water to get into the lining by lowering the side of the lining from 4 to 6 ins., and widening the berm to sometimes as much as 2 or 3 ft., which will prevent the water from getting under and damage following.

Grade and Alignment

For small canals carrying 100 c. f. s. or less the stakes should be set so that they can be used for both grade and centre line. One stake set every 10 ft. is sufficient; this should be set on the sub-grade of the back-fill or the bottom of the lining, so that a template can be set on the grade hub, and the back-fill material placed so that it comes flush with the top of the hub. By setting the grades in this way it is not necessary to remove them when the concrete is put in place.

The grade and lines should be checked after the back-fill has been placed and flooded, and before the final finish to neat lines, which is done before the placing of the concrete.

Excavation for Back-Fill

Where a new ditch is constructed with the idea of lining immediately, it is constructed to fit the cross section of the lining which has been designed and which should be an economic section; but where the ditch to be lined has been constructed for some time, and has been in use, there is generally some sod to be removed at the water line. Even if it is economical to reduce the section, it is necessary to slope these sod berms so that the back-fill will not settle away from any part that might be overhanging.

The economical crew necessary on this work has been found to consist of a sub-foreman, with anywhere from 10 to 20 men, depending upon the size of the ditch and the amount of excavation to be done. The efficiency of the crew is cut down considerably if they are strung out over a long section of the ditch.

Two men go ahead with a template to which a carpenter's level is attached so that it can be kept level, and excavate trenches at each grade hub on the sides, and bottom, if necessary, these trenches being excavated to the neat lines of the section as it is to be before the back-fill is placed. The excess material between the trenches is then removed by the remainder of the crew. No straight edge is used on this work, as it does not need to be any more accurate than it can be made with the aid of the eye. It is perhaps needless to add that the template must be kept centred on the grade hub, and level when digging these trenches.

Hauling and Placing Back-fill

The material used for back-fill may be any material that is very pervious to water, so that in case of ground water getting under the lining during cold weather it has a chance to seep away before freezing can take place.

In places where holes of considerable size are to be filled, boulders and large rocks are used to fill in, if handy, and if not, sand or gravel is hauled for this purpose, a minimum thickness of three inches being used.

The back-fill should be hauled, and where possible dumped on both sides of the canal; where the back-fill is heavy it will pay to bridge the canal. All bridges built for hauling back-fill should be built high enough to be out of the way of the lining and left in place until the lining is completed, as they will come in handy to cross when stringing out the running boards, and also may be located so as to form part of the platform for the set up of the concrete mixer.

The amount of back-fill should be checked at each grade and the line hub with template, to see that the required amount is being placed.

Two five-man crews, each with a template, under one sub-foreman, have been found to be the most efficient sized crew to employ in placing this back-fill in the canal. Any number of crews, of course, can be used, with additional sub-foremen. All sub-foremen used in the preparation and lining must work.

Back-fill should not be hauled any faster than it is being placed, so as to avoid having an excess, or an insufficient amount in any one place.

Flooding and Finishing Back-fill

In order to settle the back-fill properly and give it a good wetting so that it will not draw all of the moisture from the concrete it has been found necessary that it should be thoroughly soaked by flooding before giving it the final finish. Only a small amount of water should be used in the flooding, and this should be let in slowly to prevent washing the back-fill off from the slopes.

If there are not enough permanent checks in the canal to enable the water to be checked up to within at least a few inches of the top of the back-fill, temporary checks should be constructed at necessary intervals. For small canals and laterals a sack dam has been found the safest and cheapest to construct and to remove, and serves the purpose better than any other temporary structure.

The dams should, of course, be constructed before the water is turned in, and then allowed to fill up and run over the top, so that the upper section can be well soaked, while the section next below is slowly filling. After all sections have been soaked thoroughly, the water should be let out slowly, in order not to carry away any back-fill, or cause any to slough down from the slope; there is a tendency for this to happen if the water is lowered suddenly. After the water has drained out, the finishing of the back-fill should be started as soon as possible, as the wet back-fill works better than after it has been allowed to dry out to any great extent.

In finishing, the greatest care should be used to see that the finished section is as near the theoretical section as it is possible to make it without too great an expense, as the capacity of the lined section may be reduced considerably if it is not carefully straight-edged, this being particularly true on ditches with a steep slope. Particular care should be taken with the corners, where the bottom and the side slopes meet, as a rounding corner will hold the plasterer's straight-edge away from the slope, and will not only make a kink in the alignment of the side slope and decrease the capacity of the ditch, but will increase the amount of concrete for the lining.

The crew for this work should consist of a sub-foreman with from 16 to 20 men; there should be three men with a template, who go ahead and set the template on the grade hub, and after it has been centred and levelled thin strips are inserted under the template on the side slopes for the straight-edge to slide upon.

The upper ends of these strips are set just even with the top of the template, and should be at least two inches longer than the side slope, so that they can be pressed into the back-fill in the bottom to hold them in place after the template has been removed.

(Concluded in next issue.)

Personal Mention

Mr. R. N. Young, Superintendent of the British Columbia division of the C. P. R. Telegraphs, is making an extended tour of inspection along the company's lines in the Nicola Valley and on the Arrow and Kootenay Lakes, in the Kootenay district.

Mr. R. S. Richardson, the new Superintendent of the Armstrong-Winnipeg section of the National Transcontinental Railway, has been in Winnipeg making preparations for the inauguration of a passenger service on this line. Mr. Richardson was formerly Assistant Superintendent of the Halifax and St. John division of the Intercolonial Railway, and has been in the railway business nearly all his life.

Mr. V. W. Horwood, Provincial Architect of Manitoba, has resigned, and since his departure for treatment at an American hospital Mr. H. E. Matthews has been acting in his place. Now Mr. Matthews has asked to be relieved of his duties, and Mr. William Fingland, a well-known Winnipeg architect, has been appointed Acting Provincial Architect. According to the latest reports, Mr. Horwood is still prevented by ill health from resuming his duties, and the date of his return is uncertain.

Mr. R. H. Burrell, Fair Wage Officer, has given a definition of the term "prevailing rate of wages," which is placed in all contracts of the city of Toronto, as follows:

"The union rate of wages, of course, is a fixed rate. At certain times the prevailing rate might be the same as the union rate, or, if labor was scarce, it might chance that the prevailing rate would exceed union rates. Scarcity of work would have a tendency to lower the rate at which men would be willing to work, and thus the prevailing rate would be less than the union rate. The prevailing rate is the rate most generally paid to workmen at any period, and it may vary according to labor conditions during the course of a year."

A number of representatives of filtration manufacturing companies have been in Brockville preparing tenders on the specifications for the construction of a new filtration system there in connection with the Brockville Water-works System. The companies represented include the Pittsburg Filter Manufacturing Company, the Norwood Engineering Company of Canada, the Roberts Filtration Manufacturing Company, of Derby, Pa., the American Water Softener Company, of Philadelphia, and Norman McLeod, Limited, of Toronto.

The biggest and the best railway map in Canada is that which hangs in the directors' room of the C. P. R. general office—a map 100 feet long by 10 feet high, which took the combined efforts of three of the cleverest men in the drawing department of the company eighteen months to complete. This map is minute and comprehensive to the last detail. Every inch of railway, every islet, rearing its head in the lake or river, every city and town and village, it might be said, in the whole of the Dominion, is limned in characters which, however minute, are entirely legible.

The double tracking is shown; the course of each system from its commencement to its ending set forth; nothing has escaped the faithful and able chartographers or monographers, if one may use the words, so that at a glance the high officers of the company may see the course of the system, the river, the lake, the mountain, the stream, in any part of the Dominion.

Mainly Constructional

East and West *From Coast to Coast*

The Deakin Construction Company, Limited, has been registered at Montreal. They will carry on business as general contractors.

The firm name of the Parsons Construction and Engineering Company, Limited, of Regina, has been changed to the Parsons Construction Company, Limited.

The Buckeye Machinery Company, of Calgary, Alta., have received a Government contract for twenty thousand shrapnel shells, and are securing additional machinery and tools for their manufacture.

The Alberta Hydro-Electric Power Company, Limited, of Calgary, is considering the construction of a series of six dams and power houses, estimated to cost two million dollars.

The Provincial Government of New Brunswick is calling for tenders for the construction of the substructure of the proposed new steel bridge over the Petitcodiac River near Moncton.

The station will be flanked to the east by a clock tower about 125 feet high. The entire station will be faced with stone. The architects are Messrs. Darling & Pearson, and the contractors are P. Lyall & Sons, of Montreal.

C. Degrelle, A. Morin, B. Pellege, E. Riberdy, and J. Rossi, all of Montreal, have incorporated The Degrelle Company, Limited. They will contract for all kinds of construction work. The capital stock of the company is $20,000.

Work has been started on the rebuilding of the brass factory of the Canadian Wolverine Company, at Chatham, which was destroyed by fire recently. The extension which was planned before the fire took place will now be carried out.

Alexander Craig, Limited, have been incorporated in Montreal, Que., by F. J. Craig, J. W. Brennan, G. T. Jenkes and J. Coppold, all of Montreal. The capital stock of the company is $50,000, and they will carry on a general contracting and building business.

The St. John Street Railway Company have completed the extension of their car line to Glen Falls, three miles from the city in an easterly direction. The track line along the East St. John harbor front is now partially laid, and upon the completion in August of the Provincial Government bridge across the Reversing Falls the company will be able to link up with the west side of the harbor, where a branch line has been operating for several years. These extensions will open up splendid residential and industrial districts.

Grant, Smith & Company, of Victoria, B.C., have taken out a Supreme Court writ against the Kettle Valley Railroad for $699,609, which they claim is due them on account of the construction of that railroad. The plaintiffs also claim interest on the balance due from October 21st, 1914.

B. & S. H. Thompson & Company, Limited, metal merchants, have removed from Transportation Building to McGill Building, Montreal, while the Canada Grip Nut Company, Limited, have taken offices in the same building, having removed from the Eastern Townships Bank Building.

With a capital stock of $300,000, the Dominion Road Machinery Company, Limited, has been incorporated at Goderich, Ont. The incorporators are W. L. Horton, J. W. Kitts, R. C. Hays, C. L. Moore, and S. J. Philips. The firm will manufacture all kinds of road and agricultural machinery.

Work has been started on that portion of the Dewdney Trunk Road between Stave Falls and Mission City, B.C. When completed this section will link up this important highway with the upper section of the North Fraser Valley from Harrison Bay to the cities of New Westminster and Vancouver.

Canada's only moving picture plant, at Swansea, Ont., was totally destroyed by fire last week. The owners were the Beury Film Company, and the loss is about $100,000, of which $20,000 is covered by insurance. The plant of the Indestructible Brick Company was damaged also to the extent of $15,000.

At Montreal, Que., the firm of J. Brunet, Limitee, has been incorporated to carry on business as manufacturers of brick, tile, terra cotta, plaster, artificial stone, and cement. The incorporators are L. A. Rivet, L. G. Glass, A. Papineau, G. Duclos and A. Tarte, all of Montreal, and the capital stock of the company is $100,000.

The Eastern Steel Company of New Glasgow, N.S., have received an order from the Imperial Government for forty thousand shells, ranging from 18-pound shrapnel to 60-pound 4.5-in. high explosive shells. The company are installing new machinery, by which they expect to treble their daily output by making six hundred shells a day.

Application has been made by R. M. Rive, A. C. Jardine, C. S. Hanington and A. H. Hanington, of St. John, and John H. Harris, of Moncton, N.B., for incorporation as The Moncton West Building Company, Limited, with capital stock of $24,000, of which $5,000 is to be preference stock. The head office will be at Moncton.

The Tupper Fire Escape Company, Limited, has been incorporated at Sherbrooke, Que., by W. Tupper, C. A. Stokes, W. F. Rosencrans, G. Layfield, J. C. Nowell, L. Landry, and F. E. Woodbury. The firm will manufacture fire escapes and other safety appliances for buildings. The capital stock of the company is $100,000.

A deputation from the Manitoba Good Roads Association waited on the Hon. T. H. Johnson, Minister of Public Works, recently. They asked for a continuation of the encouragement that had been extended to them by the Department, and were told that the Department proposed to still give its support to the work of the Association and that any request would be given due consideration.

Berlin's new garbage incineration plant was opened by Mayor Hett on May 28th. There was a representative attendance of municipal officials from Ottawa, Galt, Waterloo, St. Catharines, and other Ontario towns. The plant was built by the Ideal Incinerator and Contracting Company, of Toronto, who gave a demonstration at the opening, when the carcase of a horse was consumed in seven minutes.

The Montreal Builders' Exchange have decided to maintain the schedule of wages adopted in December, 1914. The schedule terminated last month, but the members are of the opinion that conditions do not warrant any change. At a special general meeting Mr. D. K. Trotter, the Secretary, reported that the finance committee had cleared off a substantial part of the liabilities standing at the beginning of the year.

The new Toronto Technical School has been handed over to the school trustees. It has cost over two million dollars, of which a quarter of a million was expended on the site. The equipment in the applied chemistry and plating laboratory is complete, but in the other laboratories the machinery and fittings are still being installed. The power house in the basement is now practically completed, and includes a vertical engine of 300 h.p. and a large horizontal engine.

It has been suggested that a solution of the Toronto Street Railway's difficulties in connection with the elimination of the running board may be afforded by the use of steel-frame cars, which are less bulky than those of wooden construction. Engineer Royce, of the Ontario Railway Board, is paying an official visit to Philadelphia to inspect cars of this construction at the works of the Brill Car Company. It is possible that cars of a similar type may be installed in Toronto if they meet local requirements.

The gross earnings of the New Brunswick Telephone Company for the year ending March 31st last were $455,066.53, as against $422,709.45 for the previous year. The net revenue, after paying operating expenses of $351,911.91, was $103,154.62. The receipts from the exchange service had increased from $274,111.23 to $300,763.50; and the toll service produced $145,159.94, as compared with $138,854.96 for the year 1913-14. There was an increase of 1,071 telephones during the year. The company paid the usual 6 per cent. dividend.

Satisfactory progress is being made on the work of installing concrete piers for the new Bloor Street Viaduct, Toronto. One pier has already been brought to grade. The City Inspector reports that the work is being done in full conformity with the specifications. It is not expected that any of the steel work will be placed in position this summer, as it will require the greater part of the warm weather to install the concrete piers, which applies only to the Don and Rosedale sections of the viaduct. The material from the excavation work on the Don section is being utilized to fill in the Bloor Street section.

The plant of the Heaps Engineering Company at Queensborough, B.C., is being prepared for the manufacture of shells. It is expected that the plant will turn out a minimum of a hundred shells a day, the daily output being increased as the work proceeds. The company will work on part of the order awarded recently to the Vancouver Engineering Works, who are acting as the distributing agents for the various manufacturers concerned in the deal. The Vancouver Engineering Works received an order calling for a minimum of 30,000 shells within six months, and the Heaps plant will handle at least 7,500 of this number.

An arrangement has been made between the Dominion Government, the Provincial Government, and the Pacific Great Eastern Railway in British Columbia to resume work immediately on that line. Plenty of money is on hand to continue the work up to the end of the year. It is expected that by that time 223 miles of the line will be in operation, as compared with the 120 miles now completed between Squamish and Lillooet. The contractor, Mr. P. Welch, will open an employment office in Vancouver, and will engage upwards of 1,000 men in order to carry on the work. The Provincial Government will appoint a man to attend to the office and to see that none but British subjects are employed.

Work has been begun on the excavation for the new Union Station of the Canadian Pacific Railway and the Canadian Northern Railway at Yonge and Cottingham Streets, which is to be constructed at an estimated cost of over $1,000,000. The station is to be placed immediately south of the C. P. R. tracks, east of Yonge Street. It will have a frontage of approximately 135 feet, and will be about 75 feet deep, with a spacious entrance driveway to the south of the building. A large baggage-room will be placed under the elevated tracks, and there will be a driveway along the east side of Yonge Street under the tracks for delivery of baggage. The main body of the station will contain the waiting-room, 50 feet by 75 feet, and about 32 feet high, with the ticket, telephone and telegraph offices to the west, and the men's and women's rooms, with lavatories, to the east. The tracks will be reached through a concourse and a midway under the tracks; from the latter five flights of stairs will lead to the platforms.

In connection with the Montreal filtration plant now under construction, plans have been drawn up for an electrical conduit system. The current will be supplied from the aqueduct, which has been enlarged for the purpose of developing power for the water-works pumping plant, lighting, and other purposes. It is proposed to install the necessary equipment at the station at Point St. Charles, and to make the requisite connection with the filtration plant. The conduit will be 2,000 feet long. The plans include branch lines to outside lamp posts along the main line of conduit. Each joint of the terra-cotta ducts is to be provided with wrought iron dowel pins. The uniform interior cross section of the vitrified clay ducts is to be 3½ ins. square, with walls not less than ⅝ in. thick. The standard length of the duct is to be 18 inches. The fibre ducts are to have an internal diameter of 3 inches, with walls not less than ⅜ in. thick. The ducts are to be laid in a 3-in. bed of concrete. Manholes are to be made at stated intervals. The contractor will have to install forty cable racks, each complete with five cable brackets.

A conference of the Mayors, Reeves and Councillors of the various municipalities interested in the Toronto-Oshawa road was held in Whitby last week. It was decided to follow the Kingston Road route, and the Government Engineer's report on the cost of the work was received and approved. The estimates were as follows: Reducing grades, $33,915.20; open ditches, $21,362.40; tile drainage, $11,290.60; culvert pipe, $7,230.85; catch basins, $1,254; concrete wing walls for culverts, $496; bridges and culverts, $52,356.52. The total cost of this part of the work is $127,905, and the whole scheme will entail an expenditure of $237,000, which will be divided among the following: York County Commission, Ontario County, Toronto, Pickering Township, Whitby West, Whitby East, Whitby Town, and Oshawa Town. A provincial subsidy of $57,840 is also provided for. The Hon. Finlay Macdiarmid outlined the policy of the Government in connection with the building of good roads. It was the intention of the Government to classify roads under the headings of county or market roads, main roads, and suburban roads, the latter term covering roads leading directly out of the cities through the congested districts. They would agree to pay forty per cent. of the cost of building these roads, and twenty per cent. of the cost of maintaining them. Mr. W. A. McLean suggested several different kinds of roads that would be suitable for the Toronto to Oshawa highway, but in view of the probable traffic demands he recommended a macadamized road to the Scarboro boundary, and an improved gravel road from that point to Oshawa. This recommendation was adopted by the meeting, and a committee was appointed to interview the various municipal bodies, and to prepare and circulate a petition among the rate-payers.

New Electric Clock at Birmingham, (Eng.) Post Office

The first electric turret clock to be purchased by the English postal authorities was erected recently at Birmingham General Post Office. The type of clock selected by the Post Office engineers is that known as the "Waiting Train," which is a specialty of Messrs. Gent and Company, Limited, of Leicester and London (Eng.).

The new clock is fixed on the bridge which connects the new portions of the General Post Office buildings to the old. It is bolted on to the face of the bridge, the dial being five feet in diameter. Instead of the ordinary Roman characters, the clock is provided with twelve distinguishing marks as advocated by the late Lord Grimthorpe. It is arranged for internal illumination, which is provided by electric lamps within a reflector which is disposed behind the dial and is the full diameter of it.

The small amount of current required for operating the "Waiting Train" movement is taken from the accumulator in the building, which has been installed for general purposes. The mechanism is under the constant control of a master clock, the control being effected by half-minute impulses in such a simple way that contacts or additional batteries are dispensed with.

A clear reading of the dial can be obtained under all conditions: the absence of a covering glass eliminates sun glare and reflection, which otherwise might cause difficulty in reading the time at some parts of the day. The great power held in reserve by the "Waiting Train" movement renders a covering glass unnecessary. The power produced by the mechanism is in direct proportion to the load put upon it, so that the hands cannot be stopped by snow or the most severe gales. The largest electric clock in the world—that on the Royal Liver Building at Liverpool—has had to face many gales of sleet and snow in its lifetime, being exposed to the powerful weather influences that sweep up the estuary of the Mersey. Thanks to the efficiency of the "Waiting Train" movement by which it is driven, it has kept time with unfailing accuracy since it was started on Coronation Day, 1911; the heaviest gales have had no effect upon its time-keeping qualities, despite the extraordinary length and weight of the hands.

We have received an interesting booklet dealing with the comparative weights of concrete and reinforcing metal required in different types of building construction. Besides dealing with the properties of plain concrete and giving a number of tables relating to the bending moments of concrete floors, the book contains some interesting graphical charts which facilitate the selection of the proper slab depth and steel reinforcement for various spans and loadings of reinforced concrete floors. These tables show the comparative wire sizes and mesh or weave of reinforcement required. Concrete pipe reinforcement is also dealt with, following the tables. The book is issued by the Canada Wire and Iron Goods Company, Hamilton.

Bulletin No. 221 of the Link Belt Company, Chicago, is descriptive of the firm's patent Circular Storage System for large bodies of material such as coal, gravel and stone. This system has earned the reputation of being the most economical method of reclaiming large bodies of loose materials. It consists of a long-radium locomotive crane, equipped with and operating a self-filling grab bucket, travelling on curved tracks around a central point from where the bucket receives its coal. Its advantages are enumerated as follows: low investment, low operating cost, low insurance charge, flexibility, and dependability.

Trade Inquiries

The Weekly Report of the Department of Trade and Commerce contains the following inquiries relating to Canadian trade. The names and addresses of the firms making these inquiries can be obtained by those specially interested in the respective commodities upon application to the Inquiries Branch, Department of Trade and Commerce, Ottawa:

668. **Steel.**—A South Staffordshire firm inquires for manufacturers of steel sections, sheets, plates and mild steel wire suitable for electrically welding. Specifications on file at the Department of Trade and Commerce, Ottawa (A-549).

674. **Earthenware sewer pipes.**—A Newfoundland manufacturers' agent is open to receive quotations from Canadian manufacturers of sewer pipes.

716. **Wrought iron and steel tubes and fittings.**—A Middlesbrough correspondent has a demand for wrought iron and steel tubes and fittings, and would like to get into touch with Canadian manufacturers able to supply.

717. **Steel sheets.**—A Birmingham firm dealing in military equipment is interested in the supply of steel sheets, nickeled, coppered and brassed, and would like to get into touch with Canadian manufacturers.

718. **Steel boiler tubes.**—A London engineer asks for names of Canadian manufacturers of locomotive steel boiler tubes, solid drawn or lap-welded.

719. **Railway wheels and axles.**—A London firm of engineers is in the market for railway wheels and axles, and would like to get into touch with Canadian manufacturers.

720. **Sheet zinc.**—A London firm of zinc and copper roofing contractors desires to get into touch with Canadian manufacturers of sheet zinc.

721. **Cement.**—A Newfoundland merchant asks to be put in touch with cement manufacturers in New Brunswick or Nova Scotia, the latter preferred owing to proximity.

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The Personal Factor in Road Construction

JURISPRUDENCE recognizes two forms of judgment; one is based on law, and the other on equity. Law is intended to promote the interests of justice, but at times the letter of the law defeats the ends of justice, and equity becomes a consideration. We are not lawyers, but that is our conception of the meaning of these terms. We have often wondered if it were possible for the dead, hard "specification"—which at best is a compromise, limiting the hope of some owner and defining the services of some servant—to be vitalized so that the owner's wishes could be attained and the servant's services appreciated.

If one class of specification more than another may be considered a cold, dead thing, we believe that the road specification challenges competition. The owner of a road is nobody in particular. The road is not for sale. The powers that order its construction are usually not those who use it, and the majority of its users have not paid anything for it. The roadside proprietors, who pay for it only indirectly, in the majority of cases do not use it, not owning any means of locomotion other than pedestrianism, which calls for the use of roads chiefly as crossings. Pedestrians are not regarded favorably by other road users, in any case, even where no sidewalks exist. Who, then, owns the road; and to whom is its builder answerable? Yet what is a surer sign of progress and prosperity than well made and properly maintained roads? The building of bad roads, then, or the failure to use every endeavor to build good ones, is, in the first place, a form of high treason against the material interests of a community.

Everyone who uses a badly-made road—pedestrian, carter, hackman, tradesman, cyclist, autoist—suffers as the result of the builder's carelessness. And think what an uneven road means to the invalid, whose every movement is pain, and to the surgeon, the work of whose skilful hand is so dependent upon steady nerves. Who is the road builder? The contractor carries out, or endeavors to make it appear that he carries out, the specifications on which he tenders. He is responsible to the engineer who drew up those specifications. The engineer may have copied his specifications from those of some other town, or he may have prepared his own, with or without the services of a lawyer and chemist. The engineer is responsible to a Road Committee, Town Manager, or Council. The Council is the legally responsible party—and the Council is usually composed of men whose qualifications may be varied and great, but do not include any practical or theoretical knowledge of what constitutes a good form of road construction.

All of these considerations entail upon the engineer, contractor, foremen and workers a special need for conscientious, loyal service. This can be obtained only where there is goodwill and team-play. The driving, swearing, blustering foreman or boss cannot build a good road. He may build a good looking road, and may build it quickly, and add to the contractor's profits, but the maintenance of that road will cost more and its life will be shorter in proportion to the sense of injustice aroused in the minds of the men who work under him. Watch a gang working under a man whom they respect but are not afraid of, and compare it with another gang who cower in anticipation of some undeserved vituperation every time the boss comes by. In road-building, as in everything else, team-play is essential; it is good for the workmen, good for the road, and good for the community that uses the road.

The Importance of Publicity for the Engineer

WHY should we engineers be interested in publicity? Is there good reason for departing from the time-honored precept that our achievements are sufficient witnesses to their creator's ability?

He who moulds together brick and steel and stone, it matters not with what great cunning, will never rise in the estimation of those about him to a position above that of a skilled artisan. The engineer's mute witnesses of his ability are to the public mere piles of steel, long lines of railroads, or canals, or tunnels—just material things. The public must learn that we dream dreams and see visions long before a pound of material is shaped; that a part of our dreams is ever to subject the forces of nature so that man may develop the best that is in him, according to his destiny.

The man in the street is not likely to find this out unless we tell it to him in his own language. We have waited long enough for him to find it out unassisted, and our rewards bear evidence of the fruitlessness of our waiting. Unless we show that we are leaders, we shall be only workers—hewers of wood and drawers of water.

There are other reasons for proper publicity conducted by engineers, all of which may be included in the broad purpose of service to the public. One of these is to correct error and misrepresentation, so that when questions of public policy come up they will be decided in accordance with correct engineering principles rather than by the whim of the moment, directed, perchance, by some small class to further selfish ends.

The country is burdened with wastefulness where engineering skill might save vast sums. For instance, it is planned to spend a hundred million dollars on highways in New York State without adequate provision for maintenance. It is hardly possible that such a proposition would have been seriously entertained if the public had waited for the opinion of the engineering profession before making a decision. Again: Recently a proposition to spend fifty million dollars on good roads in Ohio was voted upon without any preliminary studies or surveys as to how the money was to be spent. Had the proposition been approved, the money would have been largely wasted under the direction of jockeying politicians.

At present the Government is spending millions of dollars and requiring the owners to spend many more in making a physical valuation of the railroads. When two vacancies occurred in the Interstate Commerce Commission a year or so ago, the suggestion was made to one who had the ear of the appointive power that it would be desirable to have one of the vacancies filled by an engineer. He replied that such a position required a judicial quality of mind, and that the incumbent could surround himself with all the expert service needed. His answer implied that an engineer could not be found possessing the necessary judicial quality of mind. It should be stated that the man who gave this reply was a lawyer.

There is a vast national field for furnishing engineering information to the public, which can be taken care of only by a permanent national information bureau conducted by engineers.

We have technical and research societies without number—so many that the public can hardly be blamed for believing that we are interested in material things only. Perhaps we need a national bureau to conduct and cultivate business relations with the public, including inter-society relations, publicity, employment, and legislation.

All over the country there is a growing protest against the direction of municipal affairs by the lawyer and the politician. The administration of municipal business is largely a function of engineering. Why not enable the public to see this situation in its true light and thereby perform a public benefaction as well as advance our own interests? Positions for engineers would increase in number, and compensation likewise. In the matter of seeking to prevent harmful legislation, recent events in the State of Illinois are a sufficiently strong argument to convince Chicago engineers of the need.

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*From an address before the Engineering Section of the Chicago Association of Commerce by C. E. Drayer, Chairman Publicity Commitee, Cleveland Engineering Society.

The Dominion Government's Works Programme

IT has been announced that the Dominion Government will continue the construction of all public works under contract in Canada. Apart from the war, the total expenditure of the Dominion will reach $200,000,000 for the year, while the war expenditure will mean an addition of $100,000,000. The total daily expenditure, therefore, exclusive of Sundays, will be about one million dollars, in order to maintain the existing programme and to carry on the Dominion's part in the war. The programme for the current year includes an expenditure upon public works of $25,000,000, on railways and canals of $27,000,000, and on capital account and works of harbour commissioners of over three and a half millions. Since the outbreak of the war the Dominion has made every effort to minimize unemployment in Canada by maintaining its programme of public works, including the I. R. C. terminals at Halifax, the Welland Canal, the Quebec Bridge, the N. T. R. and Hudson Bay Railroad, and terminal elevators and harbours at Halifax, St. John, Quebec, Montreal, Toronto, Hamilton, Port Arthur and Fort William, Vancouver, and Victoria.

Promotion by Competitive Examination

According to a committee on salaries and grades of the Municipal Engineers of New York City, promotion by examination tends to advance men who have a willingness and taste for studying civil-service methods and preparing for examinations, and to eliminate men inclined to give their best efforts to the work in hand. Especially is this true in professional technical employment beyond grades rated at $2,400 a year. Beyond such limits intelligent and fair appraisal should supersede examinations, excepting some effective and fair qualifying test.

Good men are not attracted and held by salaries alone, but by the conditions under which they work. The efficiency of the Board of Water Supply force compares favorably with any large public or private engineering organization. This Board has been noted also for its esprit de corps and enthusiasm for its work. These desirable qualities, the report states, were obtained by selecting the most suitable available men for the leading positions, giving great weight, not only to technical fitness, but also to those personal qualifications which cannot be learned or rated by examinations.

How Standards of Quality for Concrete Road Materials are Rising

THE successful future of concrete roads depends upon firm adherence to superior quality concrete. Sub-grading and drainage may be good, and of course must be good for any road that is to endure, but the final criterion of a concrete road as distinguished from other construction, according to Engineering and Contracting, is the integrity and durability of the material itself—the quality of the concrete. The service to be given by concrete in no other structure calls for such perfect quality of material as is demanded in a road. This truth is not a new discovery; it has long been known to the few best students of concrete roads. The new feature is that, whereas formerly the few observed the truth and the many neglected it, now the many observe the truth and only the few neglect it. One is very strongly impressed with this change when reviewing the last season's reports of municipalities that have been building concrete roads for a few years.

The quality of concrete is determined by the quality of the raw materials, by the proportioning and incorporation of these materials, and by the curing of the deposited mixtures. To the perfection of all of these things experienced concrete road builders are paying now much more strict attention than a year ago was considered at all essential, and are urging even stricter attention in future work. Practice has reached a point where a demand exists for refinement in materials for and processes of concrete production for roads. This stage of attainment in the development of the concrete road is to our mind the finest promise that we have that the concrete road has arrived.

First, in the attention being given to ensure better concrete materials, is cement. Very few communities having much experience in concrete road building fail to provide for the thorough testing of all cement. This is essential. Few materials as widely manufactured as is Portland cement rank as more uniformly of high average quality, but all cement is not test-proof any more than are every brick and every steel bar. No road job of any size fails to receive an occasional shipment of cement that has to be rejected. The safeguard is testing. To make testing practicable and to provide direct control, commissions having concrete road work in charge are adopting the plan of furnishing all cement. Besides securing control of the testing, the road authorities by this plan avoid any tendency of the contractor to reduce the cement content of his concrete. Excessive use is prevented by holding the contractor responsible for any over-run of cement and for loss of cement bags.

Aggregates for concrete for road work need, and are receiving, increased scrutiny as to quality. Pit run gravel is not accepted by many. Stone and screened gravel are required to be graded and to be kept within narrow size limits. In some work the coarse aggregate is required to conform to a set co-efficient of wear. Inspection of sand is rigid. The dirt content and the proportion of flat flakes are being strictly limited, and it is a usual demand that the grading of particles be fairly perfect. Altogether concrete road practice in the requirements for quality of concrete aggregates is superior to that in almost all other kinds of concrete construction.

The best road construction sets a high standard of perfection in the proportioning and mixing of concrete. Set proportions are commonly abjured. The aggregate is studied to determine proportion of voids, sizes, form and gradation of particles, and the concrete content is varied to conform, and as frequently as need be, with the purpose of securing density of mixture. Duration and speed of mixing are strictly governed. One road commissioner has conducted careful tests to determine the quality of mixture produced by different numbers of revolutions and different speeds of rotation of the mixer used, and on the results has set rigid requirements for mixing time and mixer speed. Here it may be noted that individual tests are positively necessary on each work where different mixers are used; for the speed of rotation and number of turns which give the best concrete with one mixer are no criterion of what another mixer will do.

The methods of curing are numerous, and the difference in efficiency between the better methods is not great. The advance in curing methods indicated by recent practice is shown rather in the care with which all methods are carried out than in devising unique methods. The curing period is lengthened wherever possible; water is supplied liberally, and the road slab is kept continuously wet; protection from wind and sun is sought.

The preceding summary of increased refinement in conducting concrete road work can be lengthened materially by adding minor details. The fact that concrete road building is becoming a very particular task of concrete construction has, however, been clearly indicated—and that is all that it was proposed to do. The contractor whose experience has been confined to general concrete construction must be prepared to accept new standards of refinement in concrete production when he enters the field of road work. It is more important to emphasize this fact than most of the other changed conditions that concrete road construction brings, because it is less obvious than most of the others. Coincidentally it should be noted that the tendency for increased refinement is bringing an increase in concrete pavement costs. The old "dollar a yard" slogan of the concrete road enthusiast is ceasing to have much of the truth that it once had. Dollar a yard concrete roads will be built in occasional places, but the concrete road of the future will most certainly exceed materially the cost of most of the concrete roads of the past—and it should do so, for unless all indications fail it will be a much better road.

Future Practice in Sewage Disposal

By George W. Fuller

THE following opinion on the probable future changes in sewage disposal practice was given at the request of the Metropolitan Sewerage Commission of New York City, and is quoted from their final report.

Oxidation Methods

These procedures are aimed essentially at the prevention of putrefaction of sewage matter, and hence deal particularly with soluble and colloidal constituents of sewage.

Dilution.—This is the prevailing method all over the world for securing the oxidation of soluble or nonsettling sewage matters wherever there is ample water to bring about satisfactory results. Without attempting to state precisely the digestive capacity of New York Harbor, it is sufficient to say that for all time to come it will oxidize under suitable conditions the clarified sewage of many millions of people. Departures from this method will be required solely in areas where the sewage cannot readily be delivered to bodies of water of sufficient volume.

The dilution method has usually been applied in this country under improper conditions. Clean watercourses can be maintained with the dilution methods, and past shortcomings should not militate against the advantages and economies of utilizing the digestive capacity of the harbor waters.

Filtration.—Where sewage cannot be applied to diluting bodies of water on account of the distance from same and the expense of delivering the sewage, filters will undoubtedly continue to serve a useful purpose. I believe the future will show no radical departures in the efficiency or cost of either sprinkling or contact filters. The tendency will be towards improvements in the design of certain details. I am clearly of the opinion that filtration has no future so far as relates to the main volume of New York sewage.

For certain areas, particularly those now comparatively sparsely populated, I think that a number of filter plants installed and operated for a period of ten to twenty years may in the end prove cheaper, even if then abandoned, than would be the case if at the outset the general plan should embody the execution of collection works for a central plant with several subdivisions.

I look for improvements in the preliminary treatment of sewage to lessen materially the odors sometimes attending sprinkling filters. For certain thickly populated districts I believe contact beds are entitled to careful consideration.

The lessening of odors requires primarily the prevention of putrefactive conditions becoming established in the unfiltered sewage by aeration, oxidizing chemicals, and probably to some extent by the application of sewage so as to minimize the opportunity for wind action to transport sewage spray.

Aeration.—I look upon aeration as a promising means of guarding against putrefaction. If conditions arise where it is necessary to deal with sewage which has to some extent undergone putrefaction I consider it possible that organic matter to a limited extent may be reduced through oxidation by air. Except for limited quantities of unstable organic substances aeration cannot be counted upon as an oxidizing agent in practice. It provides molecular oxygen, whereas the bulk of the organic matter of sewage is oxidized only by the atomic oxygen of certain powerful oxidizing agents, or the slow oxidation effected through bacterial action.

The function of aeration is essentially one of artificially prolonging the period of decomposition of sewage on an inoffensive aerobic basis. It may be that conditions will arise where the occasional application of air by artificial means will permit the dilution method to be employed, whereas without aeration or some similar treatment the dilution method would present objectionable and offensive shortcomings.

On the score of cost the aeration method for general use does not look promising; and this is particularly true of the New York conditions, where the sewage oscillates back and forth for a period of time that makes a demand on the atmospheric oxygen greater than is the case with many flowing inland streams.

Oxidizing Chemicals.—The cost of applying such chemicals as liquid chlorine and hypochlorite of lime or soda is prohibitive on account of the relatively small amount of organic matter that is oxidized. The true function of such agents is the killing of bacteria, and within certain limits they are useful as a preservative for sewage to prevent decomposition rather than to effect complete ultimate oxidation of the nonsettling organic matters.

Electrolytic Treatment.—A good deal is claimed from time to time for the economical advantages derived from the application of electricity in various types of electrolytic cells in oxidizing the organic matters of sewage. In particular is this claimed where the current may be applied to sea water. While improvements in this direction may be possible, I do not believe that they are promising enough to warrant consideration of electrolytic treatment as a substitute for the dilution method.

The electrolytic production of chemicals to precipitate certain colloidal and other non-settling organic matters may prove desirable in the future and worthy of adoption under some conditions. This method would be used, however, in conjunction with settling tanks, and could be employed supplementary to such tanks without requiring material changes in the design of tanks built for plain sedimentation alone.

Clarification

The purpose of clarification devices is to prevent unsightly sewage solids appearing in the diluting water, or the formation of sludge banks in watercourses.

Fine Screens.—Fine screens afford the cheapest way of removing visible objects of sewage origin from the waters receiving sewage where such screening treatment alone is sufficient for obtaining satisfactory results. Under conditions where the limit is at times reached in the amount of clarified sewage which a watercourse will oxidize satisfactorily, settling tanks as a general rule are cheaper to install than screens, because for a given cost they will remove a greater quantity of organic matter. Where screens will suffice for a term of years—say ten or more—it is quite possible that it will prove economical to install screens first, to be followed later by settling basins as occasion demands. American experience with fine screens is quite limited and not altogether satisfactory, owing to the devices requiring much attention and repair. This has meant not only expense, but also serious interruptions in continuity of service.

Screens are employed to much better advantage in Europe, particularly in Germany. At Dresden, Frankfort and Hamburg experiences demonstrate on a large scale that it is feasible to operate moving plate screens with an opening as small as 0.04 in. At present the so-called Reinsch type of screen, as installed at Dresden, seems to be most popular. It is of the disc type, with slots about 0.085 in. wide and 1.25 ins. long.

As fine screens come into service in America I look for marked improvements in continuity of service and freedom from expensive repair costs. I do not believe that efficiency will be any greater than that indicated by European evidence unless it should result from applying to screens sewages which are fresher and less comminuted than has been the case at Dresden, Frankfort and Hamburg.

Settling Tanks.—Sedimentation for a two-hour period at the average rate of sewage flow will give as good results as it is prudent to obtain from sedimentation. For local conditions I favor single-storey tanks with hopper bottoms, as it is undesirable to septicize the sludge at its point of origin.

The construction of settling tanks along the New York water front presents some difficulties on account of the high cost of ground, complications from salt water backing into the sewers at high tide, and the necessity of caring for storm flows. I believe these difficulties can be overcome by careful engineering study.

Fine Screens vs. Settling Tanks.—My views have been already indicated in the foregoing paragraphs. But as the question has much significance in New York I will state that, in my opinion, screens are preferable to settling tanks only where it is desirable or necessary to remove only relatively large sewage matters in suspension. Where settling solids would form deposits in the watercourses if screening alone were adopted, to install settling tanks will prove wiser than to install fine screens. Available data in this country are now too meagre to allow fine lines to be drawn in this comparison. For problems of this magnitude special study should be given before construction, not only of the relative merits of the two systems as a whole, but also of the local conditions at each main sewer outlet or groups of outlets which can be conveniently united. Both screening plants and settling plants can be operated for treating fresh sewage without creating any nuisance.

Chemical Precipitation.—The use of coagulating chemicals has been known for fifty years as a helpful adjunct in removing particles of suspended matter which are so fine that they will not subside in ordinary settling tanks. The expense of the added chemicals and the large increase in the volume of the resulting sludge is such that as a general proposition chemical precipitation is not worth while.

Sludge Disposal

In the clarification of sewage there results in all cases a substantial quantity of solid matters more or less mixed with water and ordinarily spoken of as "sludge." Experience at other large seaport towns employing sewage treatment works, such as London, Glasgow, Manchester and Salford, demonstrates conclusively that the barging of sludge to the open sea is the cheapest way of disposing of the sludge without nuisance.

Cases may arise in isolated areas removed from the water front where barging to sea will not be desirable. In such cases I advise the consideration of two-storey tanks of the Imhoff type, with the drying of the sludge on drying beds so that the residue can be carted off readily.

Use for Fertilizer.—For more than fifty years efforts have been made to employ sewage sludge economically as a fertilizer. Rarely if ever has the result been a commercial success when operations were conducted on a large scale. I do not look for any substantial change in the future, although sewage sludge may perhaps be employed as a "filler" for fertilizers. In such event it is safe to assume that the users of the material coming from settling tanks would be willing to prepare it for their processes, and if this is so it would simply mean that New York would be relieved of operating barges to sea up to the limits to which sludge is diverted to fertilizer purposes. While some slight saving in the operation of barges may be accomplished, I do not look for any substantial compensation to the city from fertilizer manufacturers who might use the sludge as filler.

Incineration.—I am aware that at Frankfort, Germany, sewage sludge is freed of water by centrifuging and the application of heat in revolving drums, so that the dried sludge may be burned with other city refuse in an adjoining municipal incineration plant. While this procedure may have a future for inland cities, the expense will never be reduced to a point where this method will displace barging to sea for the sludge of a large seaport town.

Destructive Distillation.—In a small way there are some data available as to the production of combustible gases and coke by the dry distillation of sludge. The cost of removing the water is so great that the future will never see this treatment become commercially feasible.

Sterilization.—With the existing system of combined sewers, without any possibility or necessity of making the harbor waters of a "drinking water" standard of purity, sterilization for the great bulk of the New York sewage need never be seriously considered. For some of the outlying areas where there are shell fish layings or bathing beaches I anticipate a resort to sterilization.

Miscellaneous Procedures

From time to time attention is attracted by claims for unusual efficiency or economy, or both, resulting from the employment of special types of strainers or other clarifying agents, or the use of oxidizing procedures resulting from the use of new chemicals or of new applications of electricity.

Presumably such claims will be heard of at intervals in the future, and it may be that some of them will produce more effect for a given cost than could now be attained.

I do not believe, however, that the business aspects of the New York problem will ever be materially modified by improvements in methods or devices which may become available.

As time advances a clearer understanding will be obtained as to just what is needed in certain of the subdivisions, and the progressive installation of any project as large as the New York sewage disposal problem will give opportunity to adopt in the designs the current improvements, which, as above stated, will in all probability relate to minor details rather than to underlying principles.

The Bell Falls Hydro-Electric Development on the Rouge River

By L. A. Herdt, D.Sc., F.R.S.C.

THE Hawkesbury Electric Light and Power Company have lately completed and put in operation their new hydro-electric development at the Bell Falls, on the Rouge River, about eleven miles from Calumet, Que. This development was started in the summer of 1913, but a considerable part of the work has been carried out since last July. The company's original power house of about 1,500 horse-power is also situated on the Rouge River, about six miles nearer to its confluence with the Ottawa River. The original transmission line supplies 3-phase current at 10,000 volts to the villages of Calumet and Grenville on the Quebec shore of the Ottawa River, and to the towns of Hawkesbury and Vankleek Hill in Ontario. The demand for industrial power in Hawkesbury was increasing, and the new power house at Bell Falls and the new transmission lines to Hawkesbury will bring about 5,000 horse-power to the market.

Power house.

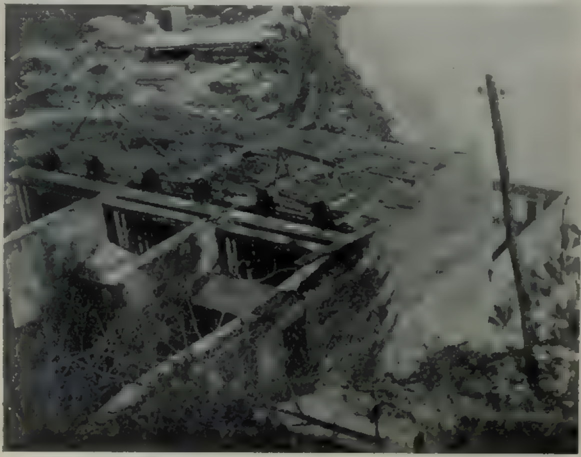
At the Bell Falls the course of the Rouge River encounters a natural obstacle formed by a spur of a hill running directly across the valley and narrowing the river channel to a gorge at the end of the spur. The river passes through the gorge over a natural fall of about forty feet, and at the head of this fall a dam has been built raising the water in the upper bay to 60 ft. above the level of the lower bay. This general configuration of the river course is somewhat common in the Laurentian district, perhaps the best known case occurring on the St. Maurice River, at Shawinigan Falls.

Head works of concrete, consisting of rack chambers with stop log checks, have been constructed on the upper bay, and a square tunnel 100 ft. long and of 17 square feet section has been driven through the rock spur, conducting the water to the fore bay and wheel pits on the hillside of the lower bay. The wheel pits, which are three in number, are open pits of reinforced concrete, with individual rack chambers, gates, and stop log checks. Two reinforced concrete wing walls running back to the tunnel entrance on the hillside form the fore bay. In each pit is placed a twin runner horizontal shaft turbine with shaft extending through the wall of the wheel pit into the generator room and directly connected to 3-phase, 60-cycle, 2,000 k.v.a. alternators developing current at 2,300 volts at 277 r.p.m.

Head works on upper bay.

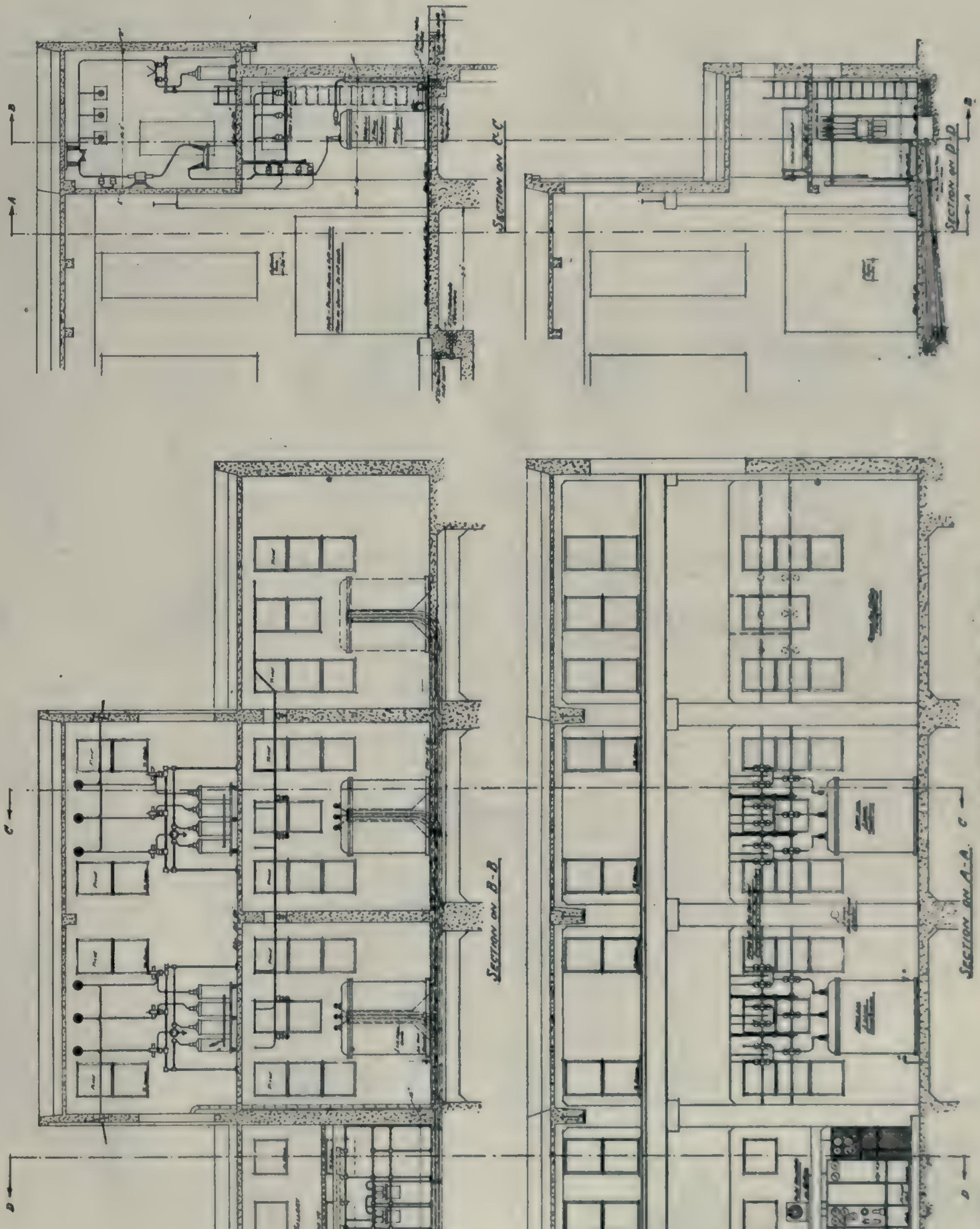
The draft tubes are constructed of reinforced concrete, and the generator floor is constructed above them.

The generator floor is constructed over the tail race for individual transformer chambers and switchboard chambers. Each chamber, which is about half the height of the generator room, is separated by a concrete barrier, but is open to the generator room. Thus transformers may be run out of their chambers on to the generator floor and handled on the travelling crane in the generator room. Slide rails embedded in the floor are provided in each transformer chamber for this purpose. Each transformer chamber is opposite the corresponding generator, and the switchboard chamber is at one end of the room, opposite the exciter bay. The generator field rheostats are located on a small mezzanine gallery above the switchboard. The line chamber is constructed above the two middle transformer chambers, and extends up to the level of the generator room roof. One line is brought in at each end of this chamber.

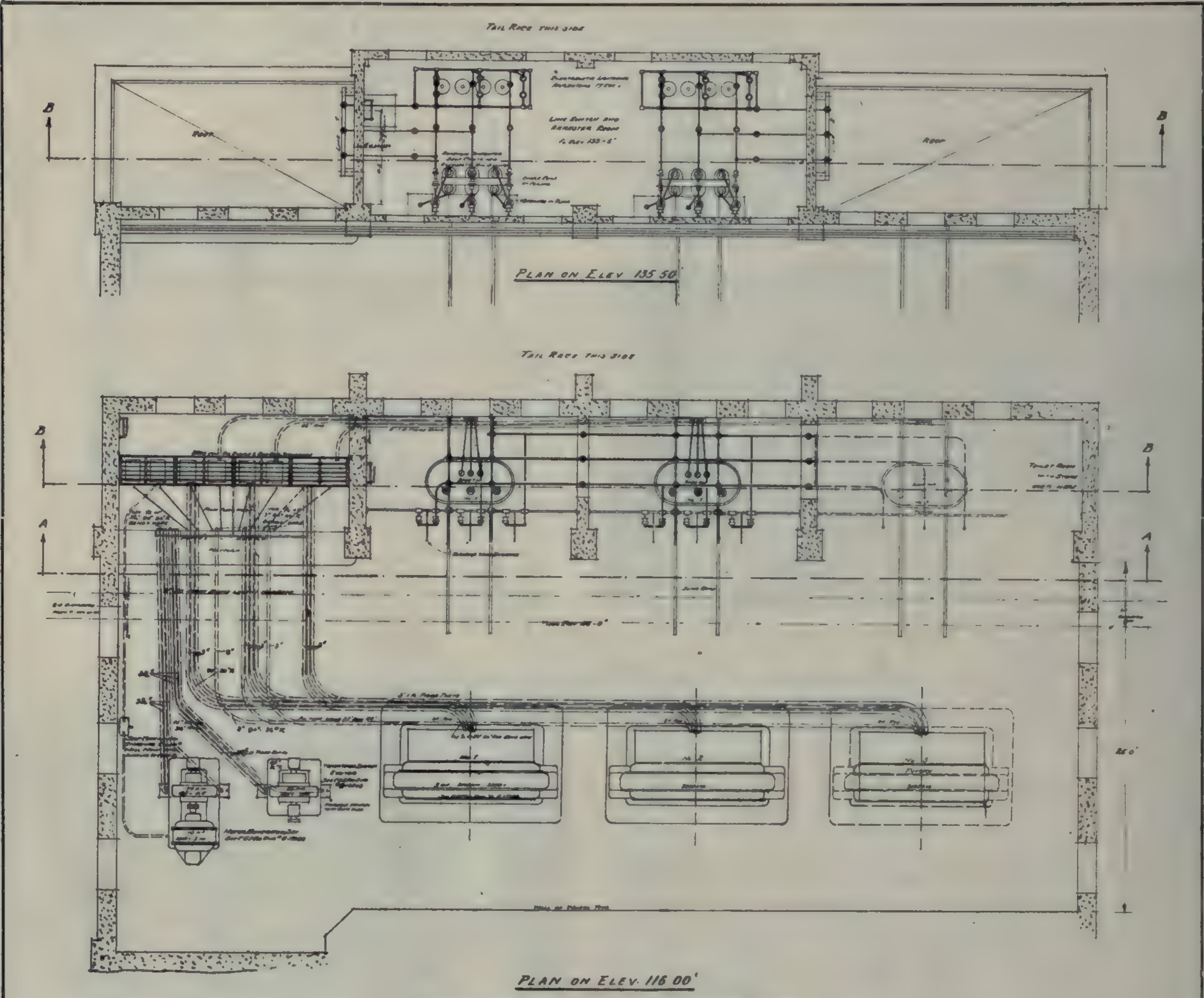


Fore bay and power house.

Two exciters are provided, each capable of exciting

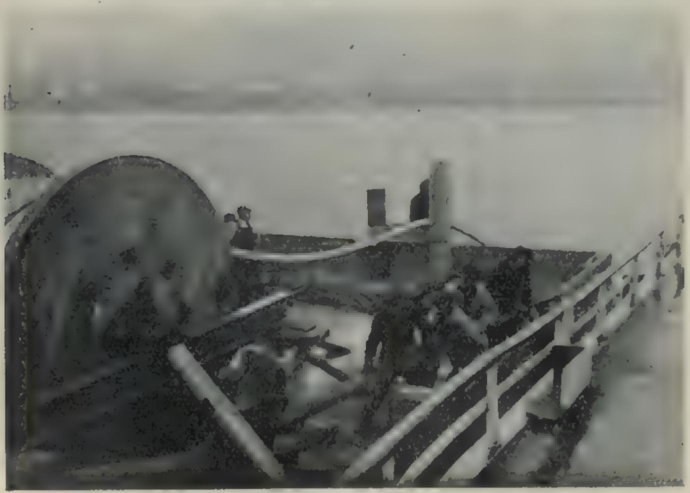


Sectional elevations of power house.



Plan showing general construction of power house.

the three alternators. One is driven by induction motor from the 2,300 volt bus bars; the other has an enclosed water wheel directly connected to it, taking water through an iron pipe penstock from the wheel pit of unit No. 1. The exciters operate at 720 and 600 r.p.m., respectively.



Laying submarine cable.

All 2,300-volt bus bars and switches are in the switchboard chamber, and are mounted on an iron pipe framework. The oil switches and circuit-breakers are mechanically operated from the panel board at the front of the chamber, which faces directly on to the generator floor.

The transformers, which are 3-phase, oil insulated, water cooled, and of 2,000 k.v.a. output, raise the voltage from the generator voltage of 2,300 volts to 17,500 volts for transmission to Hawkesbury, a distance of about fourteen miles. The 17,500-volt bus bar is located on the ceiling of the transformer compartments, and the two line oil circuit-breakers are immediately above it in the line chamber. These circuit-breakers are electrically operated by solenoid from the panel board on the generator floor. Two sets of electrolytic lightning arresters are provided, one for each line, and are installed in the line chamber.

The high voltage bus bar is merely a transfer bus and line; transformer and generator form a direct switching unit, the third generator and transformer being connected only through the transfer bus.

The low voltage switching arrangement is somewhat similar, the bus bar being used only for transfer and synchronizing and for local service 2,300-volt supply.

Transmission Line.—The transmission line consists of two 17,500-volt, 3-phase circuits, of 7-strand aluminium cable equivalent to No. 1 B. S. copper, carried on a single wooden-pole line.

Near Calumet the line crosses the Ottawa River by means of two submarine cables, one connected to each circuit, but capable of carrying all the power over one line in case of emergency. This river crossing has several features of special interest. The cables are directly connected to the transmission line, without the interposition of transformers. They are lead sheathed and armored with galvanized steel wire and insulated with paper for a working pressure of 22,000 volts. Outdoor type terminals without any housing are used at the ends of the cables, which are continuous, without joint from shore to shore, each being 2,100 ft. long. The shipping weight of each drum was 38,000 lbs., and the drums were 9 ft. 6 ins. in diameter.

One cable was laid at a time. The cable drum was mounted on bearings in a crib on a scow, and payed out as the scow was towed across the river. The laying of one of these cables is illustrated.

The transmission line will feed direct into the substation at Hawkesbury, and there the power will be distributed partly at the line voltage and also through step down transformers over the 10,000-volt lines of the Hawkesbury Electric Light and Power Company in multiple with No. 1 power house.

The power house, dam and transmission line were constructed by the Hawkesbury Electric Light and Power Company, by day labor. The power house switching equipment was supplied and installed by the Canadian Westinghouse Company. Generators, transformers and exciters were supplied and installed by the Canadian General Electric Company. Water-wheels were supplied and erected by Canadian Allis-Chalmers, Limited. The submarine cable was supplied and installed by the Canadian British Insulated Cable Company.

The Consulting Hydraulic Engineer on the work was Mr. Wm. Kennedy, Jr., of Montreal, and Mr. L. A. Herdt, D.Sc., was the Consulting Electrical Engineer, assisted by Mr. E. Godfrey Burr, Electrical Engineer, Montreal.

The Value of An Absorption Test for Wood Blocks*

WHEN municipal engineers were considering the advisability of laying treated wood block pavements some twelve or fourteen years ago, it was uncertain as to just what should be the requirements of the specifications. It was well known from previous experience that the blocks should be treated, but just what the nature of the preservative should be and how much should be used were not well known.

At that time it was proposed to treat the blocks with what was known as the creo-resinate process, that is, the preservative should be composed of one part of creosote oil and one part of resin. The theory of the resin in the preservative was that the creosote oil, being a volatile substance, would naturally lose its value under climatic conditions, but that the resin would keep it in the blocks so that its preservative properties would be more enduring. It was felt that it was necessary to prevent the blocks from decaying and also to treat them so that they should not absorb so much water as to make them swell and cause the pavement to bulge during a wet spell. Neither should they shrink too much in dry, hot weather, so that they would become loose. Twenty pounds of preservative was decided upon, but just how to be sure that the blocks were treated with this amount was a question, it not being deemed practicable to have inspection at the plant. It was finally decided that as the weight of long leaf yellow pine (the wood that was to be used) was known to be about 42 pounds per cubic foot, if the blocks would sink in water they had been sufficiently treated, and that requirement was specified.

The test for expansion was not so easy. After careful consideration it was decided to require an absorption test of the blocks. This test provided that after having been dried in a kiln at a temperature of 100 deg. F. for 24 hours and then immersed in water for an additional 24 hours, the blocks should not gain in weight more than 3 per cent. during immersion. Pavements were laid under this specification in 1903 and 1904; on one street with a specially prepared oil preservative that did not contain any resin. All these blocks conformed to the requirements as to weight and absorption. These pavements have been in use 10 and 11 years, without any expansion joint, and have required almost no attention on account of instability of the blocks.

In certain cases where pavements were not laid under the supervision of the city and the absorption test was not applied, the pavements did expand to a very considerable extent. The writer knows of one instance where blocks were laid that were supposed to conform to the absorption test but did not, and had been condemned, and these blocks expanded materially and had to be taken up and replaced.

The city of New York is the only municipality known to the writer where the absorption test is required, and it is also the only city, to his knowledge, where an expansion joint is not used. Some five or six years ago the specifications were changed so that an oil having a specific gravity of 1.10 to 1.12 was used without any resin. The absorption test was retained, however, but the percentage was increased to 3½ for long leaf yellow pine. No trouble has occurred on account of bulging, even where expansion joints were not used.

The writer firmly believes that with a heavy oil treatment and a specification requiring an absorption test, as given above, satisfactory results can be obtained without an expansion joint.

Some believe that if a less amount of oil is used there will be less bleeding of the pavement, although by the use of an expansion joint practically the same results can be obtained. Whether the reduction of 3 or 4 pounds of preservative per cubic foot will materially reduce the bleeding of the pavement when first laid is uncertain so far as present experience goes.

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* Paper before the American Association for the Advancement of Science by Geo. W. Tillson, Consulting Engineer, New York City.

It is not desirable to use expansion joints crosswise of the street, and if the use of an expansion joint along the curb is relied upon to take up an excessive expansion of the pavement due to a light treatment and consequent great absorption, it is possible that bulging will occur lengthwise of the street when it would not occur crosswise.

The Borough of Manhattan, New York City, in the 1914 specifications, has decreased the amount of treatment from 20 pounds to 18 pounds and has permitted an absorption of 5 per cent. with no expansion joint; a bituminous joint filler is used, however. Just how pavements laid under these specifications will work out in practice has not been determined at the present time. But assuming that an expansion joint along the curb will take care of all thrust in any direction on account of expansion, with a treatment of less than 20 pounds per cubic foot and a 5 or 6 per cent. absorption (although this is not admitted by the writer), the engineering question would remain whether it would be desirable to have the lesser treatment with the expansion joint rather than the greater treatment without it. As the great majority of the wood pavements of this country of long leaf yellow pine are more apt to fail through some other agency than that of traffic, the writer feels that a little extra expense in the treating of the blocks will be justified in the long run. He realizes, of course, that where the traffic is heavy or moderately heavy, so that the blocks are liable to wear out in a reasonable length of time, so much of the preservative per cubic foot is not required as upon light traffic streets.

He feels, therefore, that from the experience of Brooklyn particularly a stringent absorption test is of great value and that the expense incurred to make the blocks meet it is justifiable. He appreciates fully the inconvenience of making the absorption test, and the expense the contractors are liable to be put to if the blocks, after being delivered on the street, do not meet this requirement. The test, however, may be made at the plant where the blocks are treated, and if made by an authorized inspector of the municipality and the blocks used soon after, he believes that this trouble would to a great extent be obviated.

The Advantages of a Cement-Sand Bed for Wood-Block Paving

By Clark R. Mandigo*

PORTLAND cement should be mixed with the sand used as a bedding course in the laying of creosoted wood-block paving, for the following reasons:

1. Along streets with car lines the rise and fall of the rail and the jar of passing cars will cause the shifting of a plain sand cushion. Where water gets in around the rail this rise and fall seems to have a pumping action, forcing the water and sand considerable distances.

2. When service cuts are made a dry, loose sand cushion may run for some distance, especially on a grade, due to the blows of cutting the foundation. This displacement of the cushion may be slight, and pass unnoticed when the cut is repaved. Any settlement of a portion of the blocks causes unnecessary wear.

3. When any bulging of the blocks or other accident occurs which makes necessary the relaying of a portion of the blocks the work is more easily and accurately done where the bed for the blocks retains its original position and is smooth and hard.

4. A cement-sand bed is good insurance against the displacement of the surface due to water getting underneath the blocks on a grade and shifting a loose sand course. This would apply to springs and leaky service pipes or mains as well as to storm water.

5. Wood blocks are usually laid with a soft filler in the joints. The jamming action of heavily loaded vehicles may easily displace some of the blocks, the sand cushion shifting and retaining the displacement, and the pavement gradually becoming slightly uneven.

The writer has seen the results of the failure of plain sand cushion in all of the cases cited. Fortunately, wood blocks accommodate themselves readily to slight displacements and broom down, wearing smooth with the surrounding pavement. To insure long life and even wear, however, it is absolutely essential that the wood blocks should be placed and maintained to as true and even a grade and crown as it is possible to get. If the surface is kept true there is practically no wear on the blocks.

The term "cushion," where cement is used, is, of course, a misnomer; it should be called leveling course or laying bed: the blocks themselves are a cushion. Probably the best way to lay wood blocks is in asphaltic cement mopped on an absolutely smooth floated concrete foundation. Such a base, however, is very difficult to obtain in the present state of municipal contracting, and a cement-sand bedding course accomplishes very nearly the same results except for the waterproofing of the under side of the blocks.

The cement and sand should be mixed dry in the proportions of about 1 to 4, spread on the foundation, templated, and the blocks set and rolled in the same manner as where a plain sand cushion is used. This allows the blocks to be bedded properly before the cement has set, and avoids any difficulty in placing them on a wet mortar. After the blocks are rolled, the water necessary for the cement can be added by sprinkling the surface of the pavement, or enough moisture would probably be absorbed from the concrete foundation to set the cement. The bedding course should be only thick enough to level up the unevenness in the base, and with ordinary care in laying the concrete foundation ½ in. should be sufficient. The increase in cost of such a cement-sand course over plain sand is so slight, while the advantages gained are so important to the wearing surface, that a continuance of the use of plain sand as a bed for wood-block paving appears to be poor economy.—Engineering Record.

Notable Examples of Bascule Lift Bridges

HEREWITH we illustrate five bridges of the bascule lift type in use in Canada. This class of movable span is specially adapted to certain sites and various forms have been developed to suit local requirements.

The Cross Wall Bridge at Princess Louise Dock, Quebec, Que., is an 88-ft. span, carrying a single-track railway. The bascule is of the Strauss type with a concrete counterweight, and was built in 1911. The moving leaf weighs 110 tons, and the whole steel structure, including machinery, weighs 168 tons. The structure visible in the lower left-hand corner of the

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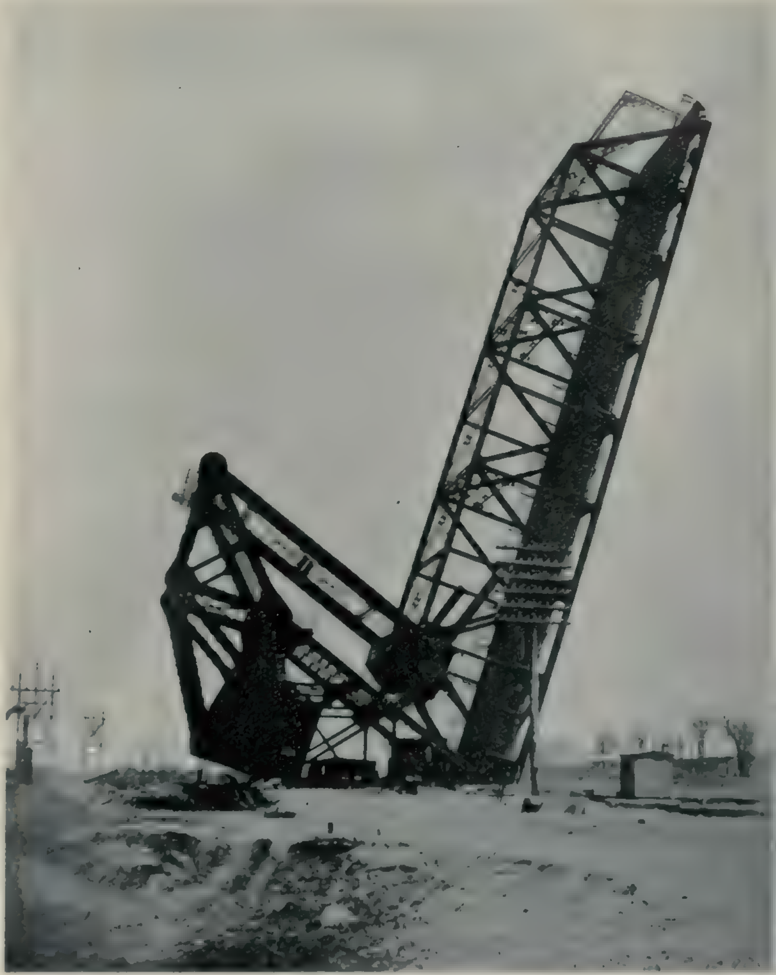
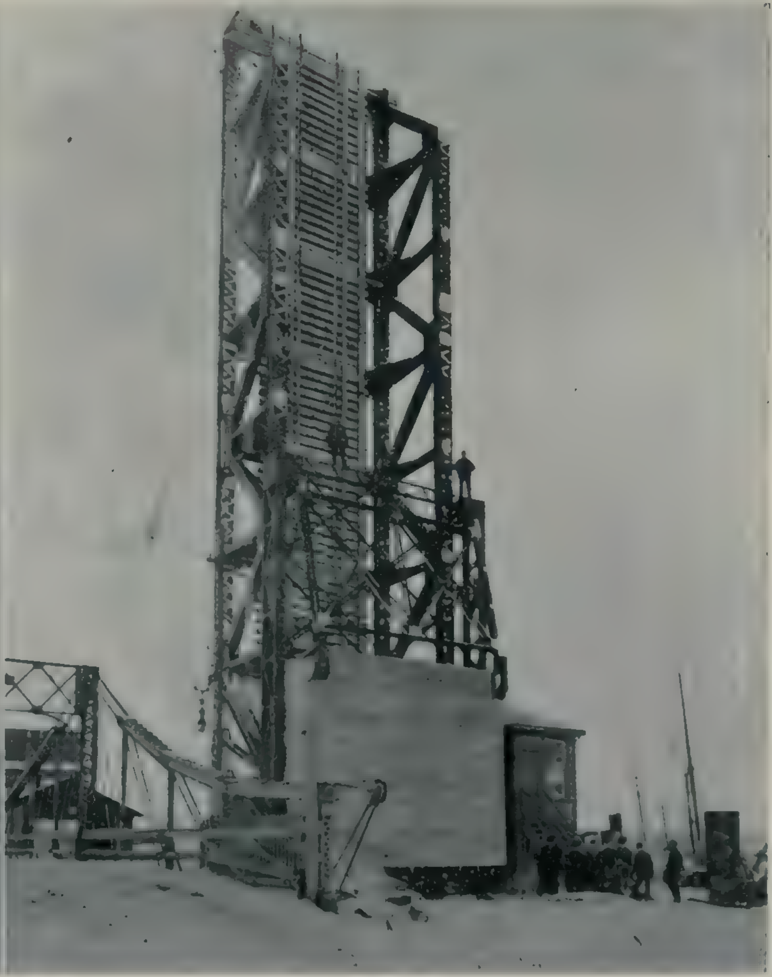
* Assistant City Engineer, Kansas City, Mo.

Bascule Bridges in Quebec

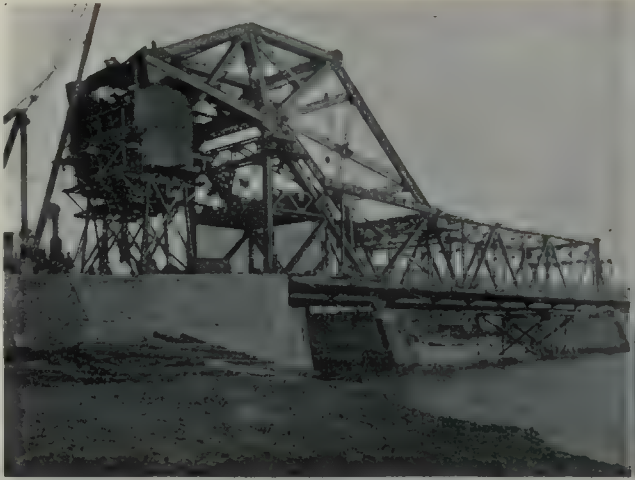


The Rockfield bascule.

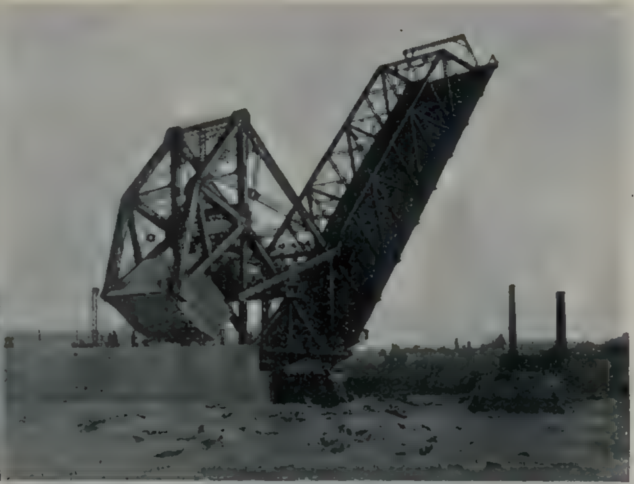


Bascule at Princess Louise Dock.

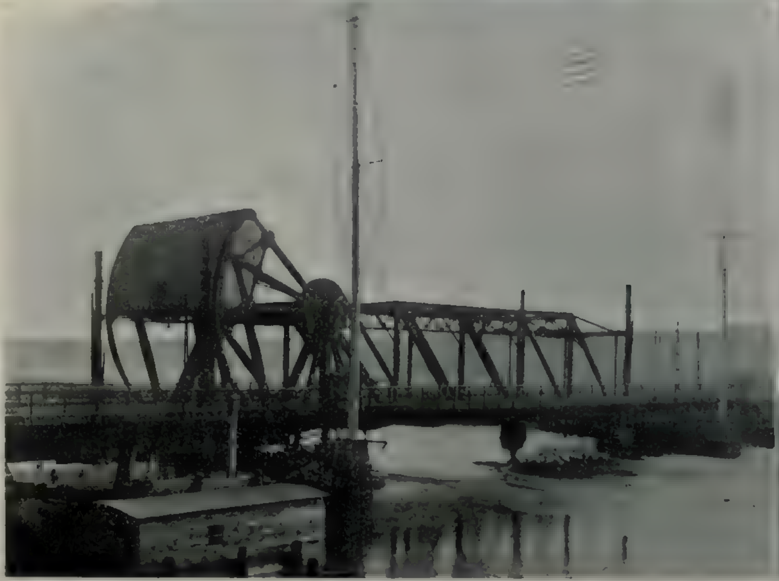
Bascule Bridges of East and West



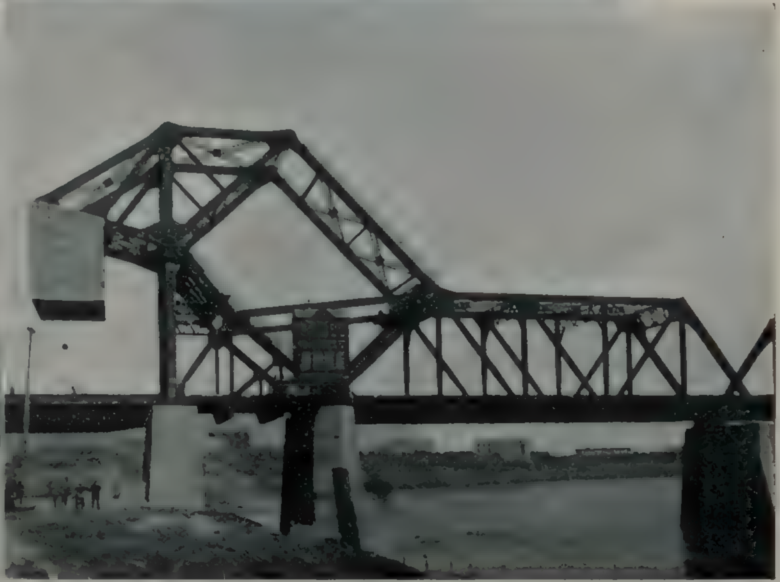
Dorchester Bridge, St. Charles River, Quebec.



The Dorchester Bridge open.



Main Street Bascule, Vancouver.



Bascule over Red River, Winnipeg.

cut is an old "rectractile" draw-span of 120 ft., built in 1888.

The Rockfield Bascule was built in 1913 for the Dominion Government and crosses the Lachine Canal about five miles west of Montreal. It, too, is of the Strauss type with the counterweight rotating on a separate trunnion. The span is 165 ft. long and carries street-car tracks and regular traffic on a thirty-foot roadway. Sidewalks on brackets are provided. The moving leaf weighs 207 tons and the weight of the whole structure, exclusive of machinery, is 417 tons. The concrete counterweight weighs about 940 tons.

The Main Street Bascule at Vancouver, B. C., was built to the design of Messrs. Waddell & Harrington, and is of the simple trunnion type. The span has a length of 127 ft. 10½ ins., and carries a roadway 42 ft. wide with two sidewalks outside. The total weight of the steel in this bridge is 398 tons, of which 327 tons is included in the moving steel.

The Red River Bascule on the National Transcontinental Railroad at Winnipeg was built in 1909 and carries a double track designed to accommodate heavy loading. This Strauss type lift span has a length of 132 ft. The moving steel in the leaf weighs 301 tons, exclusive of the operating machinery. The counterweight tower weighs 213 tons and the counterweight truss 199 tons.

Another Strauss type bascule highway span is the Dorchester Bascule over the St. Charles River at Quebec, Que., which carries a 26-ft. roadway with two sidewalks on brackets. The span is 148 ft. 9 ins. long, and weighs complete 388 tons, of which the channel span makes up 140 tons.

All the bascule lift bridges illustrated herewith were built by the Dominion Bridge Company, who lent the illustrations.

Repairing and Patching Concrete

Wet Method.—The surface of the old concrete is thoroughly roughened, cleaned, and drenched with water, and covered with a cement grout. Then the new concrete is mixed to a sloppy consistency and applied, being held in place till set by forms, as required.

From the reports received, it appears that many successes and many failures have followed this method. Where it has been successful, that result probably has been due to painstaking care and expense having been employed in the preliminary cleaning and thorough wetting of the old concrete surfaces before the new concrete is applied.

Moderately Dry Method.—The surface of the old concrete is thoroughly roughened, cleaned, and drenched with water, and powdered with cement or painted with cement grout, after which the new concrete is applied and thoroughly tamped against the old surface. Generally, such patches are kept moist by sprinkling them with water for several days.

The same comment applies here as to the wet method.

Dowel Method.—This is a modification of the two preceding methods, and is generally used for other than horizontal surfaces, although it may be applied to the latter. The new concrete may have any consistency to meet the particular conditions or the ideas of the engineer in charge; but usually a fairly wet concrete is used. This method includes drilling holes and setting dowels into the old concrete, with projecting ends to engage into the new concrete. Sometimes steel bars or metal fabric are connected to these dowels to further ensure permanency of the pitch.

This method can be made uniformly successful, but cannot be applied always. Where any considerable mass of new concrete is to be connected to old concrete, this is the only safe method to pursue.

Wedge Method.—This method includes the cutting out of defective concrete in such a manner as to undercut the surrounding good concrete so that the new concrete will be held in place, when set, by the shape of the binding edges of the old concrete.

The difficulty of under-cutting concrete so as to secure such edges is too great to make this method applicable in ordinary cases; and, except where a considerable depth of new concrete is to be put in, such under-cutting could not be done successfully, as concrete cannot be cut so as to leave sharp, clean edges.

Cleaning With Steam.—This is a method of cleaning the surfaces of old concrete preparatory to putting on a patch of new, or of cleaning the top of a rough concrete floor before applying the "finish coat." The surface of the old concrete is brushed as clean as possible with stiff brushes, and then gone over at least twice with a steam jet. An ordinary piece of ½-in. gas pipe makes a very satisfactory jet nozzle. This short length of pipe is connected to a steam hose so that it can be moved about readily. The steam is supplied by the boilers of the mixer or hoisting engines. The steam will clean and heat the concrete surface, leaving it perfectly dry; so it is important to drench the surface thoroughly with water after cleaning with steam. In cold weather it is found advantageous to use hot water. Immediately after the surface is thoroughly cleaned and drenched, the new concrete is applied.

Excellent result have followed the use of this method of cleaning; but it is essential that the surface of the old concrete be thoroughly drenched with water after using the steam jet, otherwise the new concrete will not adhere to the old.

Cleaning with Acid.—This method includes the washing of the surface of the old concrete with a solution of hydrochloric (muriatic) acid (one part acid to two parts water), after which the surface must be washed carefully and thoroughly to remove any free acid.

This is a very commonly applied method of cleaning old concrete surfaces preparatory to placing new concrete against them, and is considered by many the only safe treatment to use, especially in cases where a "finish coat" is to be put on after the concrete base is set.

An interior loading platform, to prevent street obstruction by trucks or freight, will be a novel feature of the building soon to be erected for the Eagle Pencil Company in New York City. With the exception of the main entrance hall and an inclosed storage space, the entire first floor will be utilized as a loading platform and driveway, allowing convenient movement of trucks. The platform will be accessible from two streets.

The present movement for the inauguration of better estimating methods is gaining headway fast, and the time is not far distant when the contractor will refuse to give gratuitous bids to owners, who, at their own discretion, may or may not build, or who may never have intended to build.

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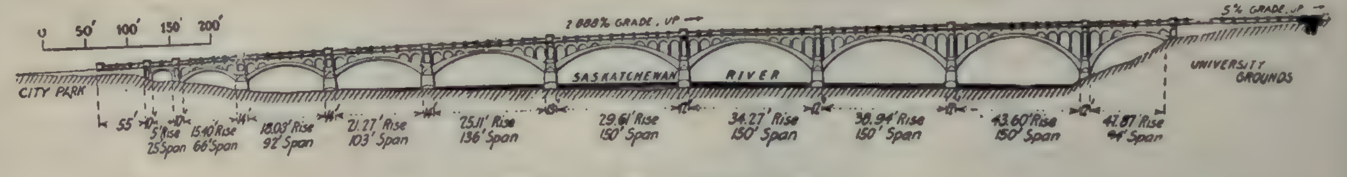
* Data collected by the Committee on Masonry of the American Railway Engineering Association.



Elevation of the new concrete bridge.

Concrete Plant Used on Saskatoon Bridge

IN the articles describing the design and construction of the new concrete bridge at Saskatoon, Sask., appearing in The Contract Record of February 10th and March 17th, 1915, mention was made of the successful use of a pneumatic concrete mixer employed by the contractors for placing concrete in the arch rings. Further details of the performances of this mixer are now available, and are given below.

The mixer used on this work was a No. 2 size, owned and leased by the Pneumatic Concrete Placing Company of Canada, Limited, of Montreal, sole agents for the McMichael Patents in Canada. The mixer has a rated cubic capacity of ½ cu. yd. of mixed concrete to a batch. It consists essentially of a cone-shaped steel shell terminating at the bottom in an 8-inch elbow with flanged connection to the pipe line through which the concrete is conveyed to place. The dry materials are charged into the mixer through an air-tight intake valve from a measuring hopper above, Water is admitted with the dry materials, and air is admitted at two points—at the top, just below the intake valve, and at the bottom, at the back of the elbow. In operating the mixer, the dry aggregate and cement, with the necessary amount of water, are admitted from the hopper, the intake valve is closed, and air under a pressure of about 80 lbs. is admitted at top and bottom, forcing the materials through the pipe at a high velocity. The materials and water are intermingled to a certain extent when leaving the measuring hopper, and the final mixing is accomplished while travelling in the pipe line, due to the materials travelling at different velocities. There is, of course, a considerable difference in the sizes, surfaces, and specific gravities of the various materials in a batch, and the presence of air aids in maintaining a variable friction in the inner and outer portions of the cross-section of the conveying pipe. The presence of a volume of air larger than that of the batch aids in reducing the frictional resistance of the pipe line, as the solids are bouyed to a large extent by the excess air. Actual movement of the batch is accomplished by the impact of the air forced in at the elbow, assisted by the expansion of the compressed air from the mixer to the end of the pipe line.

The mixer used at Saskatoon was located on the side hill at one end of the bridge, enabling the contractors to handle materials to the mixer by gravity from the top of the hill. The materials used consisted of graded gravel with stone, mostly under 2-inch size. The gravel was hauled by teams, and unloaded on a stock pile from which the bins were filled by team scrapers. The aggregate was drawn from the bins into a measuring hopper, where the cement was added. For concreting the arch rings the pipe line was laid on a trestle along the middle of the bridge carried on the centring, the axis of the pipe being about on the level of the floor line. The pipe line ended in a discharge box, from which portable chutes were laid to the point of final deposit. This mixing plant was used to place all concrete after August, 1914, until cold weather set in, in December, and established a record for Western Canada for yardage of concrete placed. In the first two weeks during which the plant was operated this mixer placed over 2,600 cubic yards, and a single arch ring, aggregating 500 cubic yards, was concreted in 17½ hours of operating time. With the delivery end of the pipe line 375 feet from the mixer an average of fifty batches an hour was maintained, and at 1,000 feet thirty-five batches an hour was the output over a lengthy running period. The speed of operation depends upon the efficiency of the men operating the mixer, the amount of air available, and the length of the pipe line, assuming that the materials can be supplied to the mixer at the rate required. On the particular plant in question one man was able to attend to the charging of each batch, including adding the water, and one man attended to all the operations necessary to mix and convey the batch to place and, as stated above, an average of fifty batches an hour was maintained over a number of days.

For this work the contractors used an 8-inch, lap-welded, steel delivery pipe, with cast steel elbows. This size pipe line will require about one cubic foot of free air to a lineal foot of horizontal pipe line. Air was furnished from two Ingersoll-Rand straight line compressors driven by two 75 h.p. Canadian Westinghouse motors. At full load the compressors delivered each about 400 cu. ft. of free air a minute at 80 lbs. Near the mixer was placed a steel receiver of 125 cu. ft. capacity, acting as a reservoir, under a working pressure of 110 lbs. to a sq. in. It has been found that only about 5,000 cu. yds. of concrete can be placed through spiral-riveted and lock-joint steel pipe before leakage develops, but that English seamless steam pipe will deliver 10,000 to 15,000 cu. yds.; while the life of oil well casing may be measured by the delivery of 18,000 to 20,000 cu. yds. of concrete. Cast iron, 90-deg. bends should have a radius of not less than 5 feet, and generally will need replacing after passing about 2,000 cu. yds. Long radius cast steel elbows will deliver from 15,000 to 20,000 cu. yds., depending upon the aggregate.

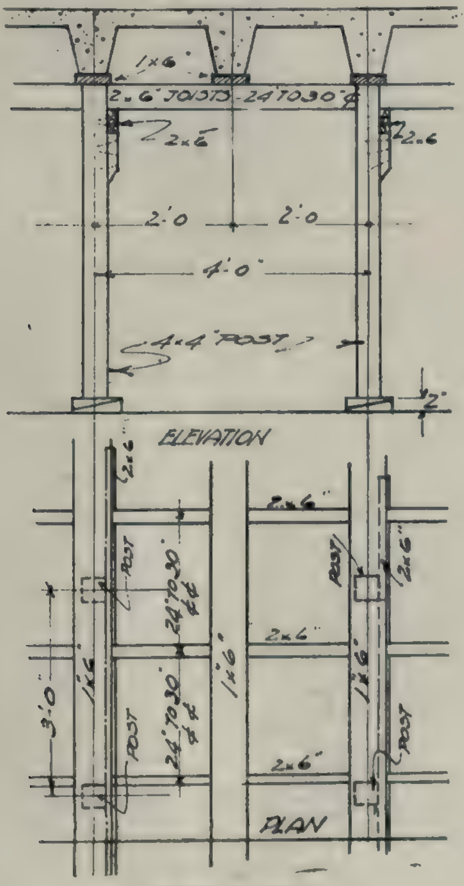
The cost of such a system of mixing and placing concrete is made up of (1) the cost of compressor air plant, including power and air lines, and installation; (2) installation of pneumatic mixer and pipe line, including renewal of discharge pipe line, if any; (3) royalty for the use of the system; (4) operation of entire plant.

The first two items, of course, will vary according to conditions and locality; the third—the rental or royalty—is usually set at 20 cents for each cubic yard of concrete placed; the fourth item is also variable, but the direct labor charge for mixing and placing should seldom exceed 5 or 10 cents for every cubic yard of concrete.

This type of mixer has found its best use in the placing of concrete lining for tunnels, but has been used successfully on many types of construction work, particularly in placing concrete in river bridge piers. It is in use elsewhere in Canada on the walls and dam of the 40,000,000-gallon reservoir for the Montreal Water and Power Company, on the lining for the Mount Royal Tunnel, Montreal, and for the power development at Niagara Falls, and has been selected for use in placing all the concrete for the new trunk sewer tunnels in Vancouver. The contractors on the bridge at Saskatoon, which is being erected by the province of Saskatchewan and the city of Saskatoon, are Messrs. R. J. Lecky & Company, Limited, of Regina.

Details of Shoring for Large Concrete Building*

THE accompanying illustration shows a very interesting feature in connection with the concrete work on the Garden Court Apartments in Detroit in the winter of 1914-1915. The building is about 107 ft. wide, 185 ft. long, and contains two wings, each measuring about 40 ft. by 40 ft. It is 100 ft. high and has about 147,000 sq. ft. of floor surface. The concrete frame-work was designed along the lines of standard practice. The floors are of Floredome construction as shown in the sketch.



Sketch of shoring.

Form work for the entire building was erected complete before any stripping was done, no shoring whatever being re-used. The reason for doing this was the installation of one floor every 5 days, and as an extra precaution, due to the fact that the concrete roof was poured two weeks before any stripping was begun.

There were 14,000 pieces of 4-in. x 4-in. studs, 10 ft. long, used for shoring, being spaced from 3 ft. to 4 ft. on centres. To the uprights were nailed 2-in. x 6-in. planks, which supported 2-in. x 6-in. joists, spaced from 2 ft. to 2 ft. 6 in. on centres. The joists supported 1-in. x 6-in. planks spaced 2 ft. on centres, which in turn supported the steel Floredomes used as centring for the joist floor construction.

The particular type of metal forms ordered for the job was found to be unsatisfactory for the large columns in the basement and the ground floor. For columns 26 in. x 26 in. in size and up, the metal forms bulged badly at the bottom, due to the hydrostatic pressure of the wet concrete and to the frail construction of the forms. They were soon discarded after pouring several columns, and not even tried for the smaller columns in the upper storeys.

The concrete work was protected from freezing by enclosing the building with canvas and keeping salamanders burning for three days after placing the concrete. It cost about $10 a day to operate these salamanders on each floor.

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*Concrete-Cement Age.

Plaster Lining of Irrigation Canals

By Calvin Casteel

(concluded from page 617)

For small ditches whose side slopes do not exceed 4 ft. in length ordinary plaster lath has been used with very satisfactory results; for larger ditches 1 x 2-in. material serves the purpose. Four men are employed on the straight edges; these straight edges are made of 2 x 4-in., 12 ft. long, planed smooth on all four sides. One man works on each end of the straight edge. The first time it is stroked with the straight edge the flat way, and for finishing it is run on edge to remove any excess material that may be left, on account of the straight edge springing when flat; a straight edge is worked on each slope. Behind the straight edge crew, from five to ten men are employed in shovelling out the excess material and levelling up the bottom. Back of these four more men are employed, one on each berm and two in the bottom. The two men on the bank are employed in cutting the berm level with the top of the strips which have been set with the template. The men running the straight edge should mark the top of the berm with the straight edge by pressing it back from the top of the strips, and thus making a mark that these shovellers can follow. These shovellers should use long-handled, square-pointed shovels, and the berm should be cut level for a distance of not less than 10 ins. The two shovellers in the bottom are employed in finishing the bottom ready for concrete. They also use square-pointed shovels, to make the square corners at the junction of the bottom with the side slopes.

Aggregate

The Okanogan Project is very fortunate in having an abundance of aggregate. A long haul is hardly ever required, as aggregate of a good quality can generally be found near the work. Seldom is a haul of a mile required.

Pit run has in general been used, and everything has been screened out that will not pass a one-inch screen. This leaves generally a preponderance of sand, and is just what is wanted for plaster lining. Tests as to the volume of voids in the aggregate are often made, and the amount of cement necessary has varied from 1:4½ to 1:5½, generally running about 1 to 5.

Equipment.—The mixing on the Okanogan Project has been done with a Northwestern ¼-yd. power mixer, equipped with a self-loading bucket and a rotary pump for supplying water.

It has been found economy, however, to have the pump run by a small engine of 1½ h.p., separate from the mixer. The pump and engine are both mounted on a small platform, which could be moved from one set-up to another by hand, unless a long move was made, in which case it was hauled in a wagon.

The pump was placed at the upper end of the section to be lined, where the water supply is, and a 1¼-in. supply pipe run from the pump to the mixer. The length of this pipe varied from 300 to 400 ft., depending on the length of the set-up and location of the mixer, the mixer being set up as near the centre of the section as the local conditions would permit.

This method of furnishing the supply of water for mixing has been found far better than the old plan of working pumps with the engine on the mixer, as in this case it was necessary to run the supply pipe in the bottom of the ditch to the mixer, because it was impossible to get the joints tight enough so that the pump would life the water from the ditch, at a distance of from 300 to 400 ft. When the pipe was laid in the bottom of the ditch it was something of a handicap for the plastering crew working on that end of the section.

The platform for the mixer is set on solid ground whenever possible, and in a good many cases where the lower bank was narrow a temporary bridge was built across the canal and the mixer set on this. The minimum size for a mixer platform is 16 x 16 ft., and in most cases this was increased to 16 ft. by 20 ft., with the mixer set cross-wise on one end. The platform is nailed down in all cases to make it solid, so as to facilitate the movement of the wheelers to and from the discharge door of the mixer.

The time of discharging the batch of mixed concrete from the mixer with the wheelbarrow is one of the limiting conditions to the maximum output, and special effort has been made to eliminate all delays at this point. There should be an incoming and an outgoing runway in each direction, to avoid confusion at the mixer. The mixing and placing is handled by one sub-foreman, who must be a very energetic fellow, and who can see to the details which aid or hinder the total day's work of the crew. He must also be ready at all times to lend a hand on anything that may come up and need immediate attention.

The runways used for the wheelers were 1½ x 12-in. and 1½ x 10-in. planks, 16 ft. long; the latter were just as convenient as the former, and seemed to last longer without splitting at the ends, besides being easier to handle and cheaper in first cost. Two complete sets of mixer platforms and running boards were used, the set not in use being moved ahead for the next set-up, and were all in place when the mixer was ready to be moved. Where there is a low bank, and the concrete lining comes near the top, the running boards should be set out at least three feet from the edge of the lining, where it is possible. They can be set closer when necessary, but if they are set closer the wheelbarrows bother the plasterers when working near the top of the lining, and this should be avoided if possible. Wherever it can be done, the bank should be levelled off for the full length of the set-up on the outside of the running boards, so as to provide a return runway for the empty wheelbarrows. If it is not economical to do this, frequent turnouts should be made so that the empty wheelbarrows can avoid the loaded ones without losing any time.

The platforms for dumping the concrete on, at the point where it is used, are 6 x 6 ft., set on trestles 2 ft. high. One-inch boards and 2 x 4-in. are used in making these platforms and trestles. In the case of small ditches, the platforms are laid across the ditch from bank to bank, while in medium sized ditches, of the right height, one trestle is used in line with the ditch, and the other end of the platform is put on the bank. These platforms are moved ten feet at a time.

Mixing.—The cement and gravel are placed in the loading bucket together, and the water is started running with the mixing drum as the bucket starts up to discharge. In this way all the batch is mixed to the same consistency. The mixing should be continued for one minute and sufficient water applied to make it wet enough to spread easily. The man who runs the engine operates the loading bucket and the water supply. The operator signals the man at the discharge door when the batch is ready. Two or three men are required to load the bucket with gravel, and one to handle the cement. It takes two and a half minutes to mix and unload a batch.

Wheeling.—A good concrete wheelbarrow, having a guaranteed capacity of 3 cubic feet of wet concrete, is needed for this work. The number of wheelers required depends upon the length of the set-up, and height of runways above tables. Under average conditions, with a 100-ft. set-up, ten wheelers can keep the mixer running to full capacity.

Plastering

The tables or plastering for a 600-ft. set-up, which is the best length to use under average conditions, are located as follows: Table No. 1 is at the upper end of the section; Table No. 2, 140 ft. below No. 1; Table No. 3, 300 ft. below No. 2; Table No. 4, 460 ft. below No. 3. All four crews work in the same direction, which keeps the total average length of haul the same until the section is finished. The difference in the length of sections for the two middle and the two end crews is made on account of the concrete being harder to plaster and finish after it has been hauled the greater distance. When concrete is hauled from 400 to 500 ft. it is necessary to remix it after it is dumped on the tables, on account of its settling while being hauled. On this account the length of set-up should not exceed 700 ft., which makes the average haul 350 ft.

A placing crew consists of one shoveller and two plasterers, which in small ditches is reduced to a shoveller and one plasterer. The shoveller uses a No. 2 scoop, and the plasterers have a wooden float, a plasterer's trowel, a template or straight edge, and a jointer. The shoveller places the concrete on the bottom and slopes, where the plasterers can spread it out evenly with their float and then finish it up with their trowels. Every 10 ft. an expansion joint is made; several kinds of joints and jointers have been tried. The easiest and most satisfactory joint was made with a common plaster lath sharpened on one edge. To make the joint, this lath is pressed into the concrete to a depth of 1 in. and then removed, and the crease made is stroked lightly with a trowel to smooth down any rough edges that might be made when the lath is removed. The plasterers use a straight edge on the berm and on the side slopes to gauge the thickness of the lining, and in case the ditch bank is so high that the plasterers cannot work from the bottom, a ladder is used which is laid flat on the slope, and has a straight edge on one side the right thickness, to which he lays the concrete. In all cases, when the plasterer moves his ladder or template, to which he is laying the concrete, he strokes the edge of the finished concrete with his trowel and gives it a bevel. If this is not done a small crack will appear where the union is made.

The plasterers work opposite each other, and take turns in finishing the bottom. In some cases, where it is convenient, the wheelers dump the concrete on the slope to the plasterer on the side next to the runways; this saves shovelling and enables the shoveller to give more time to placing the concrete for the other plasterer. Both corners, where the side slopes join the bottom and the berm, are rounded slightly, which gives a much better appearance. A good plasterer on this work should plaster from 5 to 6 cu. yds. of concrete in an eight-hour day, providing he is furnished with material all the time, making from 1,080 to 1,296 sq. ft. Two men have done 16 cu. yds. in one day, making for one man 1,628 sq. ft.

Water Supply

The water supply is kept up with the mixer by building sack dams at the lower end of the section just completed and letting the water down for each move as it is made. A sack dam was found most convenient, as the water could be easily controlled when letting it out. On account of the concrete being green, it is necessary to let it in slowly at first, until it has reached the next dam and started to back up, when the flow can be increased. As the dam cannot be built until the upper section is finished, it is necessary to take precautions to have everything in readiness beforehand, as for average moves the water supply is the last thing ready, and with a pay-roll of from $10 to $12 an hour any delay of the whole crew on this account may increase the cost of a move from 50 to 100 per cent.

When the pump was attached to the mixer, from 300 to 400 ft. from the water supply, it was necessary to lay the pipe in the bottom of the canal, so as to have a gravity flow up to within 30 ft. of the pump, as a rotary pump would not deliver a sufficient supply, on account of air leaks at joints, and it also required some time to get it started, which increased the cost of moving considerably. With a separate pump and engine, the pipe can be laid on the bank out of the way of the plasterers, and can be moved in about half of the time, without damaging any lining in taking it apart at the union and getting it up on the bank.

The supply pipe has a union every 100 ft., so that it can be uncoupled for moving from one set-up to the next. Where the canal is comparatively straight the 400 ft. can be moved in one piece by placing a man at each 20-ft. joint. This is much quicker and cheaper when it can be done, and does not require any more men, as there are always plenty of men available for this work.

A track man is employed, whose duty it is to see that the runways are kept in order, and who also assists the placing crew when making a move with their table. The runway board, from the runway to the table, always comes down from the slide away from the placing crew, so that the wheelbarrow load is always dumped on the side nearest to the shoveller. Two or three boys are employed to keep the sides and bottom of the ditches well sprinkled with a sprinkling can, just ahead of the plastering crews, as the surface is apt to get dry before the concrete is laid.

A roustabout team is employed, to haul away boards and platforms ahead to the next set-up, and also as one of the teams in moving the mixer. One of the teams employed in hauling aggregate is used when needed in moving the mixer from one set-up to the next. One man is employed in keeping wet the concrete that has already been laid; this is wet from four to six times a day for a week after it has been laid. The cost of this work is lessened, and better results obtained, by keeping the water backed up in these sections as high as possible with sack dams. This should not be done, however, for at least 24 hours after the lining is placed, as there is danger of the thin lining being broken up if a high head of water is backed upon it before the final set takes place. In case the weather should be cold, and there is any likelihood of frost, it is well to cover the concrete before the day is finished with 2 or 3 ins. of earth, which, under ordinary circumstances, will protect it until it can withstand the frost.

Efficiency of the Lining

One of the essential factors that has determined the cost of the lining on the Okanogan Project is the cost of the cement on the work, which until last spring was $6 a barrel, but we are now getting it for $3 a barrel. With this comparatively cheap cement, the lining has been done for about $12.50 a cubic yard, as against $18 to $22 when the work first started. The cheapest lining cost $11 a cubic yard, and the costliest $13.90, being respectively 5.1 cents and 6.4 cents a square foot. The cheaper lining has not all been due to the price of cement: a constant improvement in the methods of doing the work has aided greatly in reducing this cost.

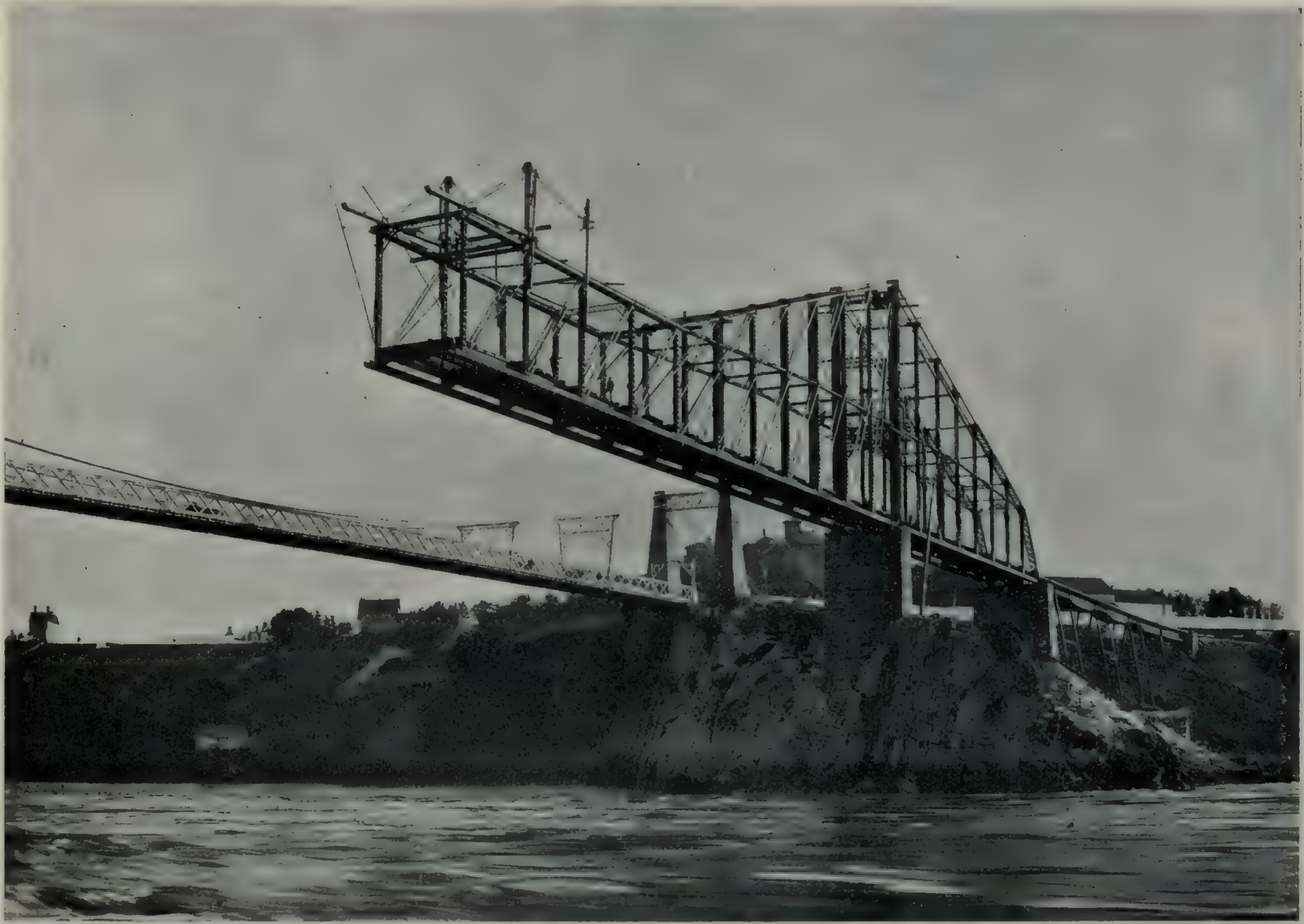
Determining Voids in Fills by Puddling

DO not place too much trust in a fill which was partially made a generation or two ago. The older portion may be the more treacherous. Perhaps trees and brush were used in making the original fill. If they have decayed, the fill is in a honeycombed condition and likely to give way. The best method of locating voids is by puddling. Enclose your sub-grade with temporary earth dikes 2 ft. higher than the sub-grade and divide it into compartments by similar cross dikes. Fill the compartments with water, one at a time, and weakness, if any, will shortly appear. The usual method of relying on a roller for compacting a fill is not nearly so efficacious. In my experience, not more than 10 per cent. of the fills can be properly compacted with a roller alone.—Extract from a paper before the Northwestern Road Congress by James M. McCleary.

Moulds for concrete newels, finials, rails, balusters, spindles, balls, caps and bases for piers, etc., should be so constructed that they can be removed piece by piece without injuring the casting. Their strength and rigidity must be ample to withstand tamping and other strains without distortion.

Broomed surfaces for concrete roads are not so common now as they were. Brooming merely weakens the surface and presents a series of projections which greatly increase abrasion.

The St. John Cantilever Bridge



Constructing the cantilever over the St. John River.

The description of the new highway arch bridge over the St. John River, published in a recent issue, recalls the construction of the Cantilever Bridge at St. John, N.B., which was one of the Dominion Bridge Company's earliest contracts. This bridge spans the famous Reversible Falls of the St. John River, and serves as the only railway entrance to the town of St. John from the west. The above view illustrates the construction in 1884, and shows the light top chord traveller building out the cantilever arm, the shore arms having been erected on falsework by a high wooden outside traveller. The bridge was built for a special company with the purpose of joining up the Canadian Pacific on the west side to the Intercolonial on the east. The principal dimensions are as follows: length of bridge proper, 813 feet, with channel span 477 feet; length, including approach trestle, 1,220 feet; width, 20 feet centres; maximum height, 80 feet over pier; total weight, 4,465 tons.

Expansion in Concrete Sidewalks

CONCRETE sidewalks may be generally divided into two classes with reference to expansion troubles—those in which there is a strip of earth between sidewalk and curb, except at street intersections, where the sidewalk pavement is continued to the curbs (as shown on the accompanying plan); and those in which the concrete sidewalk covers the entire surface from the buildings on one side to the curb on the other, says the Municipal Journal. In the latter construction there will almost invariably be a durable pavement on concrete foundation extending across the roadway from curb to curb, while such pavement may or may not exist in the other case.

Concrete expands by an appreciable amount under the effects of either heat or moisture, late investigations indicating that moisture has even more expansive effect than heat. This tendency to expansion is very powerful, and yet not irresistible, as is seen from the fact that a continuous mass of concrete extending from building line to building line across the street could not expand without moving the walls of the building, which apparently it does not do. In such cases there is, of course, an internal compressive stress produced by the pressure of the structures which prevent the expansion. In the first class of pavements referred to above, the sidewalk tends to expand, and the longitudinal expansion is resisted only by the curb across the end of the sidewalk. If this is not sufficiently strong and well anchored to resist the force of expansion, it is pushed outward. When the sidewalk contracts again, the tendency is for each block to contract individually, widening the joints between blocks, which fill with dirt, small stones, etc., which tend to render permanent this widening of the joint. When the pavement next expands, therefore, it pushes the end section a little further, and so by small increments the end of the pavement creeps gradually further and further from its original position. It would seem, therefore, that either the curb at the end of the sidewalk must be sufficiently strong and well anchored to resist the thrust of expansion, or it must be allowed to move, with serious detriment to its usefulness and appearance. There is a third alternative, however, that of designing the construction that the expansion may expand itself in some other less objectionable direction. Such an idea is indicated in the sketch, Fig. 2, in which the pavement is cut into two wedge-shaped blocks adjacent to the intersection. The two heavy blocks at the corner furnishing considerable resistance, which is greatly assisted by the foundation of the roadway pavement, these two wedge-shaped pieces marked c c will have the tendency to move inward from the curb, which movement is resisted only by the soil, the resistance of which would presumably be considerably less than that offered by the corner pieces. Weak points in this construction would be the acute angles caused by the diagonals, but this point can be strengthened by bevelling the edge of the pavement so as to give the pointed end of the block a triangular rather than a knife-edge section. This bevelling of the edge would also assist somewhat in permitting the blocks to move as intended, by causing the earth to slide up the inclined edge. This would, of course, throw the wedge-shaped blocks slightly out of line, but this would not be nearly as objectionable as the same amount of movement in the curbs. A strip of thin metal left in the diagonal joints would facilitate this movement.

Another method of treating the problem would be to carry the sidewalk pavement continuously to the face of the curb, as shown in the lower cross-section in the sketch, resting it upon the concrete or other gutter material, which at this point is carried back under the curb; placing a joint of about a sixteenth of an inch of tar between the under side of the sidewalk concrete and the gutter, which tends both to make this joint watertight and also to permit sliding under temperature expansion and contraction. Reinforcing rods would then be carried back through several of the sidewalk sections, being especially well anchored near the curb line so that movement of the sidewalk due to expansion should not be permanent. With such construction, the face of the sidewalk in line with the curb would move very little out of line. Should this movement become objectionable in amount, the concrete could be cut back and refaced at comparatively small expense.

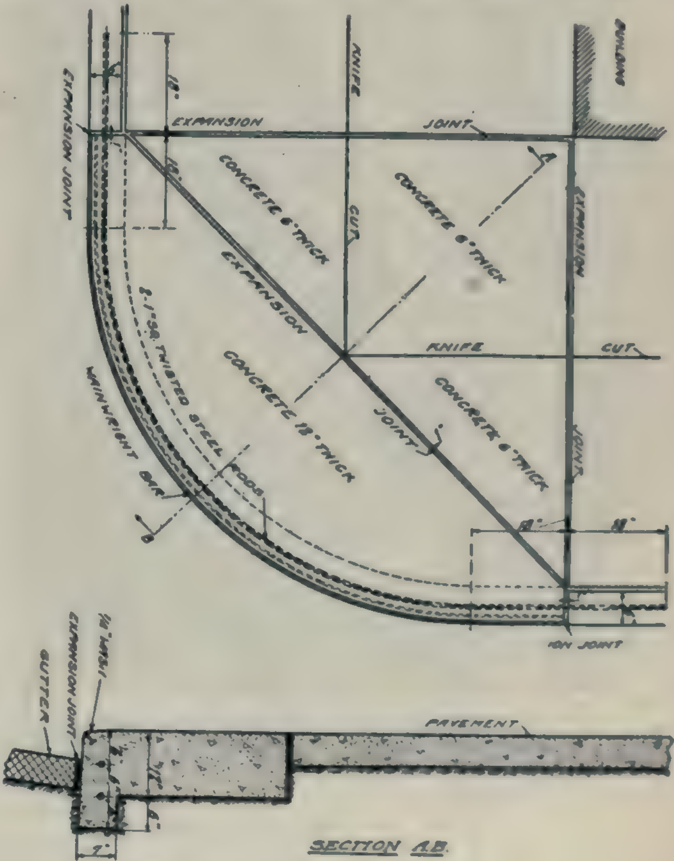


Fig. 1.—A successful type of concrete corner.

Probably the simplest method of attempting to overcome all of this expansion trouble is to use expansion joints. These have, we understand, given satisfactory service in some cities, but owing to the comparatively weak resistance to expansion offered by a light curb we anticipate that under many conditions it will not prove a sure remedy.

The second case, that of a sidewalk continuous from building to curb, is the most difficult to treat, because here no motion is possible without overthrow-ing the curb, except such as is provided for by open joints, whether filled with expansion material or not. The force exerted against the upper edge of a curb by such a sidewalk and a similar force exerted by a concrete roadway foundation at about mid-depth, can be successfully resisted only by the strongest curbing, such as heavy granite or a very heavy concrete. In some cities this difficulty has been met by carrying the sidewalk concrete across the top of the curb, but the joint between the sidewalk concrete and the top of the curb is almost sure to weather or otherwise break into an open joint which is disfiguring and very apt to increase until the edge of the sidewalk becomes very ragged. What seems to us a more satisfactory plan has been adopted in a number of cases in both large cities and small towns. This is the construction shown in the lower section of the accompanying drawing and already suggested for the intersection of narrow sidewalk and curb. It consists in not using any curb at all, strictly speaking, but in finishing off the edge of the sidewalk so that it takes the place of the curb, this edge resting upon the concrete or other gutter as shown. (This assumes that concrete curb would be used and is sufficiently durable for this location. Should granite or other more substantial material be desired, the ordinary construction would of course be used). Here also there would be a slight tendency to progressive motion due to dirt sifting into the joints when the pavement contracts, but this motion would not be considerable nor its results serious. If it is desired to avoid it, however, reinforcing rods could be used, tied back into the inner block. They could be anchored either by bending the forward end of the reinforcement, by using an anchor plate, or by anchoring the rod in a plate used for protecting the edge of the curb. In some cities the entire face of the curb, in streets where traffic is heavy, is protected by a steel plate extending from the gutter to the top of the curb, the reinforcing rods being provided with heads which are countersunk in the face of this plate. The strength of the reinforcement should be sufficient to overcome the friction of the sidewalk sliding on the cinders beneath it and on the gutter as it contracts to its original position. The cost of this reinforcement would be less than that of providing a substantial curb as in ordinary construction.

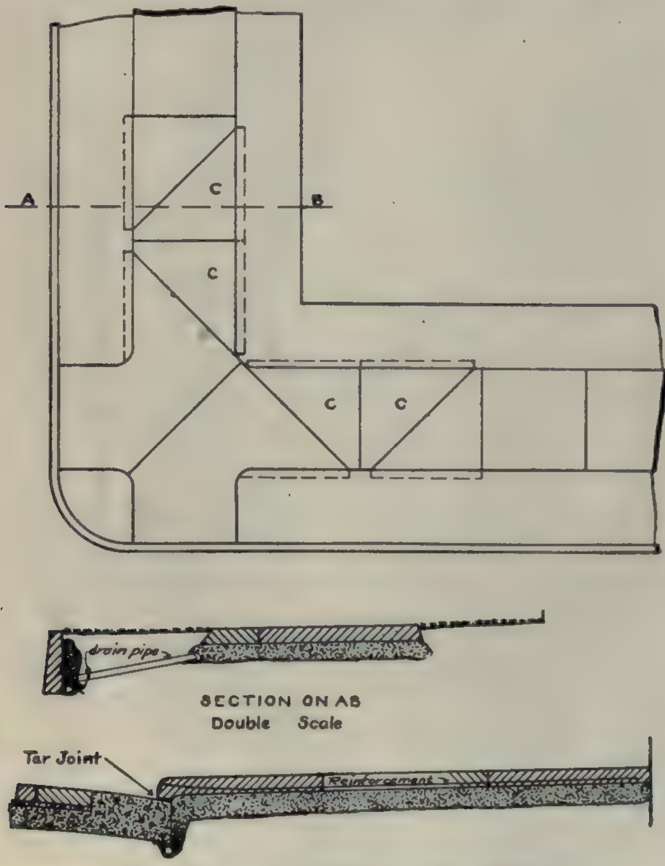


Fig. 2.—Proposed construction of concrete sidewalk.

Curbs are often thrown forward by the expansion of freezing ground. This can be prevented by ensuring that the ground behind the top half of the curb is kept drained. Where the ground is naturally sandy or gravelly, and there is any outlet for the ground water close to the surface, there is generally no trouble of this kind. Where the ground is of clay formation, however, it is desirable to place gravel, broken stone, clean cinders or some other material which will readily allow water to pass through it, from the base of the curb up to within an inch or two of the surface, placing on top just enough soil to provide for the roots of sod. It is desirable to connect this curb drainage, either continuously by a layer of gravel or at intervals of from ten to thirty feet by small pipe, with the porous foundation provided under the sidewalk pavement to drain the latter. This construction will permit the water to drain to the bottom of the curb, but unless it is removed from there this will be of little benefit. Where the grade is fairly steep, all that is ordinarily necessary is to provide an outlet for this blind drainage system into the sewer catchbasins or whatever other outlet is available. It is safer, however, especially where such outlets are very infrequent, or where the grade is quite flat, to place a small tile drain behind the curb at its base in order to remove the water which seeps to this point.

Another concrete record of 322 cu. yds. placed in eight hours by a ½-cu. yd. mixer was made at Balboa, Canal Zone, on April 19, according to the Canal Record, in concreting the south wall of dry dock No. 1. The mixer was one of four, normally operated in pairs. Its mate was out of order on this day, and both crews, numbering twenty-nine men and one sub-foreman, were doubled on one mixer. The total labor cost was $34.87, or 10.8 cents per cu. yd. Labor on this work, however, is only paid 13 cents an hour. Delays amounted to one hour and forty-five minutes, so that the concrete placed per hour of working time was over 51 cu. yds. measured in the form. The mixer turned out seventy-nine batches per hour while running, as each batch in place averaged slightly over 0.65 cu. yd. It is estimated that during this running time each of the eighteen men engaged in wheeling aggregate to the mixer must have handled 147 lbs. of gravel per minute.

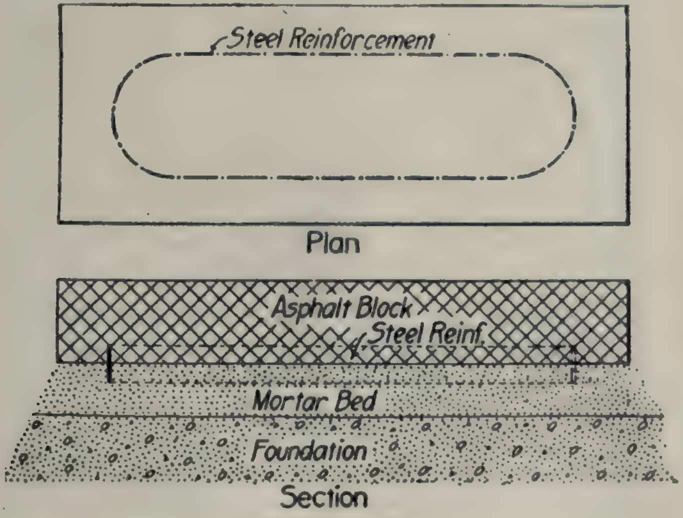
Layers of concrete should not be tapered off, but be built with square ends. When from any cause it becomes impracticable to complete a layer, a plank of convenient width should be secured to the form, against which the concrete should be rammed, thus making a vertical joint.

The City Treasurer of Vancouver, B. C., will feel the effect of the reduction of travel over the street car lines resulting from the growth of the jitney bus traffic. It is said that the city's revenue from the street car lines will be decreased this year by about $30,000.

Anchor Block for Asphalt Block Pavement

ASPHALT paving blocks are made 12 ins. long, 5 ins. wide and 2 ins., 2½ ins. and 3 ins. thick. They are a mixture of trap rock, limestone dust and asphaltic cement moulded under a pressure of 240 tons. In reinforcing macadam roads the old surface is brought to grade by scarifying and thorough rolling; soft spots are filled with concrete and over all is spread about 1 in. of Portland cement mortar, 1:4 mixture, just wet enough to be readily struck true to line. The blocks are bedded in the fresh mortar, the layers standing upon the blocks already laid. If the pavement does not extend from curb to curb, the edge of the pavement is secured by concrete edging or a border of anchor blocks. By thus adapting an old-tried and proven material to a new use, many miles of heavily-travelled macadam highways can be converted at moderate cost into permanent highways which otherwise would be a source of endless expense and annoyance.

Where firm old macadam foundation is not available or where the macadam is too thin to be serviceable, a foundation of Portland cement concrete is laid ranging from 4 ins. to 6 ins. thick. When blocks are laid upon a concrete foundation they are bedded in fresh mortar about ½ in. thick and the surface of the finished pavement is covered with a thin layer of clean sharp sand. The sand is broomed into the joints as thoroughly as possible and the surplus left upon the surface for thirty days, during which time traffic works the sand into the joints. Asphalt blocks are malleable, and the action of traffic irons the top edges of the joints together so that in a few weeks the joints have almost disappeared and the surface is smooth and water-tight.



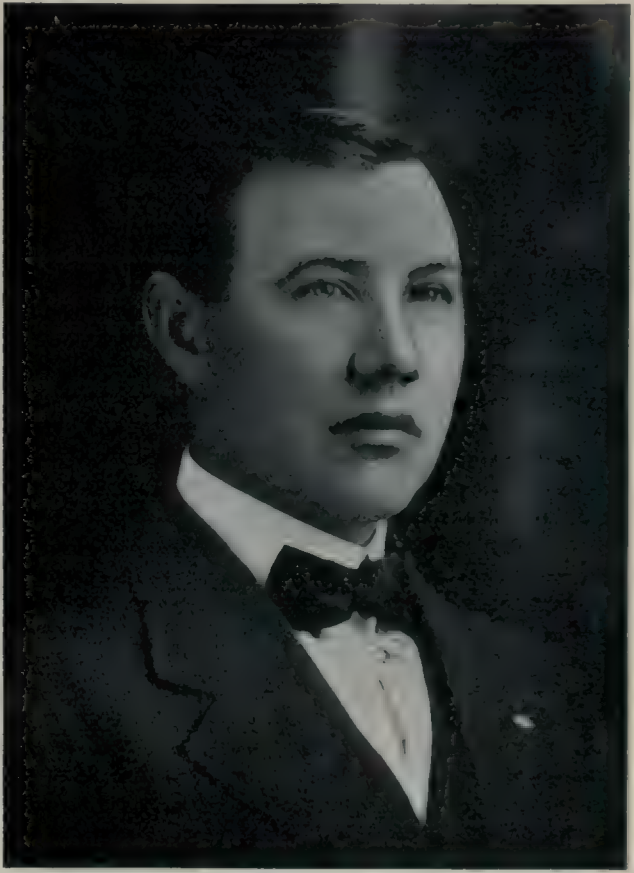
Detail of anchor block.

As motor truck traffic increased, it was found that the severe vibrations and pushing action of these vehicles had a tendency to crowd the asphalt blocks out of line and in extreme cases to distort the blocks. To remedy this trouble, an anchor block was devised as illustrated in the sketch. A steel strip 1 in. wide, shaped like an elongated letter O, is forced ½ in. into the block and projects ½ in. into the mortar. The anchor blocks are prepared at the plant and a row of them is laid across the street at intervals as required. This has effectually stopped movement of the blocks. The anchor blocks have been successfully used as borders, thus dispensing with expensive concrete edging.

This description is abstracted from a paper on Asphalt Block Pavement in "Cornell Civil Engineer," by Geo. P. Hemstreet.

Personal Mention

MR. W. H. Carter, whom we present to our readers this week, is President of that well-known Winnipeg contracting firm, The Carter-Halls-Aldinger Company. He was born at Bismarck, Illinois, in 1874, and received a good grounding in building construction in the school of practical experience. In 1900 he became Superintendent of Construction for the William Grace Company, of Chicago, for which firm he went to Winnipeg as branch manager in 1903. Four years later he organized the firm of which he is now President. Mr. Carter was President of the Winnipeg Builders' Exchange in 1910 and 1911, and again in 1914.



Courtesy of International Press

Mr. W. H. Carter, of Winnipeg.

Mr. R. H. Balfour, of the Montreal Light, Heat and Power Company, has been appointed Chief Engineer of the Montreal Electrical Commission.

Prof. A. A. Stoughton, of the University of Manitoba, attended a meeting of the Town Planning Commission in Detroit last week as the representative of the city of Winnipeg.

Mr. C. Ross Cameron, Sales Manager of the William Hamilton Company, Limited, Peterborough, Ont., resigned his position recently to go to the front as commander of the machine gun battery, Third Contingent. Mr. Cameron had been with the William Hamilton Company for about fourteen years, and during most of this time he was associated with the 57th Battalion. Mr. G. R. Munro, Chief Engineer, has assumed the duties of Sales Manager in addition to those of his own department.

Mr. Arthur Putnam Scott, who has been appointed head of the metallurgical department of the Snyder Electric Furnace Company of Chicago, is a Nova Scotian, and graduated from McGill University, Montreal, with the degree of B.A. and the Logan gold medal for natural sciences in 1896 and with the degree of B.Sc. and the British Association medal in chemistry and metallurgy in 1898. A year later he became assistant chemist with the Dominion Iron & Steel Company of Sydney, N. S., and was appointed chief chemist and assistant metallurgist of that company in 1904. He resigned this post in 1908 to enter the service of the General Electric Company, Schenectady, N. Y., as representative metallurgist at the Brackenridge plant of the Allegheny Steel Company. In 1911 he was recalled to Sydney as metallurgist and superintendent of the steel department of the Dominion Iron & Steel Company. Until recently Mr. Scott has been engaged in consulting work, with headquarters in Montreal.

The death is reported of Thomas L. Delaney, President of the Anderson & Delaney Contracting Company, Limited, Montreal.

Mr. C. F. Dibblee, C. E., died at Woodstock, N. B., recently. The late Mr. Dibblee had been in poor health for some time, and had not been engaged in active work since the completion of the Transcontinental Railway, with which he was connected.

Mainly Constructional

East and West *From Coast to Coast*

The Norwood Engineering Company, Cowansville, Que., have commenced work on the erection of a new factory for the manufacture of shells.

The National Iron Works, Limited, have been granted a certificate of incorporation at Vancouver, B. C. The capital stock of the company is $25,000.

The Kingston Brick and Tile Company at Seeley's Bay, Ont., who have been turning out large quantities of drain tile, are about to commence manufacturing brick.

The Oranova Brick Manufacturing Company have started work at Welland, Ont. The site of their plant has a frontage of a quarter of a mile on the M. C. R., which railway will run a switch into the works. The company will operate on the co-operative plan.

At Kincardine, Ont., the Hunter Bridge and Boiler Company have received an order for 25,000 4.7 shells. The order is required to be finished in October, and is worth about $150,000. It will require the working of day and night shifts to get the work out on time.

After numerous delays, there is a probability of the Montreal new building code receiving final consideration by the Council. The compilation of the code has been in preparation for several years. It has been modified and rearranged, and is now ready for the Council's deliberations.

It is understood that work will commence on the Canadian Northern Railway, close to the Manchester sub-division, near Calgary, Alta. A large contractor's outfit is now encamped close to the C. N. R. station, ready to commence work on the grading of the Macleod branch of that railway.

The firm of F. R. Wilford & Company, Limited, has been incorporated at Lindsay, Ont., with a capital stock of $50,000. The incorporators are F. R. Wilford, M. M. Wilford, G. H. Hopkins, G. E. Donaldson, and A. E. Gregory, all of Lindsay. The firm will carry on a general construction business.

Special machinery and plant is being installed in the factory of the St. Thomas Metallic Grave Vault Company, at St. Thomas, Ont., for the manufacture of 25,000 shells of the 18-lb. high explosive variety. The contract was awarded recently, and operations will start as soon as the machinery is in place.

Work has been started on the laying of the outfall of the North-West Sewer System, Victoria, B. C. A single length of 36-inch steel pressure pipe 132 feet long is to be floated out in one section and sunk. A diver is to be employed in constructing a concrete platform upon which to lay the steel pipe.

The annual statement of the Dominion Steel Corporation was an agreeable surprise to the shareholders. The company earned all its fixed charges and the corporation preferred dividends, and had a balance of $345,000 applicable to subsidiary preferred issues. The net earnings of the corporation and its constituent companies were $3,571,058.98.

Designs for three new bridges have been submitted to the Winnipeg City Council, drawn by Mr. Paul Schioler in collaboration with Prof. A. A. Stoughton, of Manitoba University. The proposed new bridges are to be constructed on Main Street at a cost of $191,276, on Maryland Street at a cost of $141,680, and on Arlington Street at a cost of $126,379.

St. Lawrence Machinery, Limited, is the name of a company incorporated recently to carry on the business of machinists and mechanical, electrical and civil engineers at Montreal, Que. The incorporators of the company, which has a capital stock of $50,000, are C. F. Smith, E. E. Cummings, Jr., H. J. Trihey, P. Berovitch, and E. Lafontaine, all of Montreal.

The Spartan Machine Company, Limited, has been incorporated at Montreal, Que., for the purpose of manufacturing and dealing in all kinds of railway, mining and builders' and contractors' supplies and materials. The capital stock of the company, the incorporators of which are E. E. Howard, J. DeWitt, H. C. McNeil, W. H. Howard, and H. E. A. Rose, is $50,000.

Four members of the Civic Engineering Department, Vancouver, B. C., have been working long hours preparing plans for the repair of the Connaught Bridge, several spans of which were destroyed by the recent fire. It has been necessary to make new copies of the original plans, and a scheme is being arranged for the better protection of the viaduct in case of another outbreak of fire.

The City Architect's Department, Toronto, are preparing a heating by-law the chief object of which will be to see that all heating apparatus are installed properly. A considerable amount of damage is done each year by the blowing up of boilers due to faulty installation, and the by-law is intended to make it possible for the city authorities to see that all valves in hot water systems are fitted properly, so as to guard against the danger of explosions.

At Hamilton, Ont., the City Council have adopted the recommendation of the Board of Control regarding an agreement with the Canadian Cartridge Company, which provides for the sale of two acres of land to the company at $4,500 an acre. The company will start work at once on the construction of buildings at a cost of between $30,000 and $40,000, and when the plant is in full operation it will give employment to some two hundred men, working day and night shifts.

Hastings County Marble Company, Limited, is the name of a firm incorporated recently at Toronto for the purpose of mining and quarrying marble, stone, and other materials. The company will acquire the McGrath property in the township of Marmora, Ont., and the water power known as the Ellis Falls in the township of Belmont. The capital stock of the company is $100,000, and the Provisional Directors are G. B. Balfour, M. Crabtree, J. Parker, J. M. Duff, and L. H. Page, all of Toronto.

The Canadian Locomotive Works Company, Kingston, Ont., have just concluded a new contract with the Canadian Shell Committee for the British Government which will keep the works busy for the next year. The company have been making shells since last November, and they are now able to produce 700 finished shells a day. The new contract calls for shells for 4.5 guns, and also for 60-pounders, and it is expected that three hundred men will be needed in addition to the four hundred now employed.

The Quebec Public Utilities Commission have ruled that the financing of schemes is outside their jurisdiction. The question arose when the Montreal Electric Commission submitted plans for the construction of further underground conduits. Two companies interested raised an objection to the work on the ground that financial conditions were adverse. The Commission, however, declared that they had nothing to do with this, their authority being limited to the approval, modification, or arrangement of the plans.

Considering the adverse conditions, the earnings of the Peter Lyall & Sons Construction Company, Limited, Montreal, for the year ending March 31st last were satisfactory. They totalled $209,677 net, compared with $230,405 last year and $258,697 in 1913. Bond interest absorbs $71,984, the sinking fund $40,000, and the preference dividend $91,000, leaving a balance of $6,693, which, with the previous balance brought forward, gives a total of $82,830. The company have secured an order for the manufacture of 4.5 howitzer shells.

The contract for the construction of the second unit of the main channel jetty on the Fraser River, at Steveston, B. C., has been let to the Marsh Hutton Powers Company, Limited, the contract price being in the neighborhood of $400,000. The contract calls for the completion of this second unit, which is 7,100 feet in length, in twelve months from the date of the contract, and the contractors will start work almost immediately. The jetty will be of brush and rock construction, and about five hundred men will be employed on the work.

The members of the Vancouver branch of the Canadian Society of Civil Engineers have organized an engineering corps which will carry on every type of field work practised by engineers in actual warfare. Mr. R. F. Hayward, General Manager of the Western Canada Power Company, is the Commander of the corps, and the members will erect a 100-yard rifle range, with trenches, land mines, and replicas of various offensive and defensive works, on a tract of land obtained from the Canadian Pacific Railway Company southwest of Shaughnessy Heights.

At a recent meeting of the Saskatoon Builders' Exchange in the Board of Trade offices, the committee appointed to meet the delegates from the Trades and Labor Council, representing the plumbers, carpenters and painters, with respect to rates of wages for the present season, reported the result of their interview. The committee felt that until there was some prospect of building operations opening up it was impossible to come to any definite agreement. They decided, however, to report back to the Builders' Exchange, and the chairman of the committee was instructed to bring in a written report at the next meeting of the Exchange, outlining the different grievances of the various branches of the building trades, more particularly with regard to the bricklayers (who were not represented at the interview), and also to suggest remedies.

One hundred thousand dollars' worth of constructional material of all descriptions, from cement mixers and diving outfits to chisels and hammers, has been purchased from Canadian manufacturers and distributors by the Canadian War Purchasing Committee during the last few weeks. Mr. W. Shives Fisher, a member of the firm of Emerson & Fisher, of St. John, N. B., represented the Commission, and has closed the last of the orders.

All the material secured is to be used in connection with the operations of the Canadian Overseas Railway Construction Corps, which was organized some time ago by the C. P. R., and which has been stationed at St. John, N. B., since February 15th. The Corps has now acquired its full strength of slightly over 500 officers and men, and is under the supervision of Col. Ramsay.

Inspectors are at present supervising the manufacture of the purchases and it is expected that all material will arrive at St. John on the specified date.

The work the corps will engage in at the front, although not yet definitely known, is expected to be that of constructing strategic railway or other bridges. Motor cars for the quick transportation of supplies from the base to the front have been purchased, and everything for which there is likely to be the remotest need has been secured. All the officers of the Corps are experienced engineers, about half having been in the employ of the Canadian Pacific Railway when hostilities commenced. The privates have also had actual experience in the building of bridges and other construction work.

The Board of Directors of the National Paving Brick Manufacturers' Association at their quarterly meeting held in Cleveland, Ohio, May 27th, affirmed arrangements tentatively made for holding its annual meeting October 11-12 at Dayton, Ohio. The annual meeting of the American Society of Municipal Improvements will be held during this week. This arrangement will enable the members of the National Paving Brick Manufacturers' Association to attend the meeting of the American Society.

Montreal's Paving Difficulties

The city of Montreal is having a considerable amount of trouble with the tenders for cement and asphalt sidewalks and the supply of asphalt. When the tenders for laying cement sidewalks were opened, we understand that it was found that the F. J. Jago Company, Limited, had made a deposit of $20,000, which was $32.92 short of the necessary ten per cent. on the price of their tender. The City Attorney thereupon ruled that it was out of order, and the Board of Control awarded a contract to another firm, whose tender was the second lowest on the list, but $7,712 higher than that of the F. J. Jago Company. Further inquiries elicited the fact that three other contractors who had made bids were short in their deposits. One was only a cent short, another $1, and a third $8.33. These tenders were also put aside, the net result being that the city will pay about $40,000 additional by adhering to the strict letter of the law. The city will get about two-thirds of this work, being the lowest tenderers for certain sections, while Henault & Hefferman have been awarded a considerable amount of work.

With regard to asphalt sidewalks, the Controllers have accepted the tender of the Sicily Asphalt Company for laying mastic asphalt sidewalks at $1.98 per yard, the city tender being 50 cents a yard higher. Controller Ainey, who favors day labor, dissented, and expressed surprise that the city prices were so high, particularly as the city had been able to underbid contractors formerly. Mr. Mercier, the Assistant Engineer, explained that previously the city had tendered too low in some instances, while this year he had added 10 per cent. for maintenance. A statement is to be prepared showing the cases where the prices quoted by the city have been insufficient.

Objection has been taken in the Council to a recommendation by the Board of Control to award a contract to the Simplex Paving Company for re-surfacing certain streets at 40 to 45 cents a yard without calling tenders. The Controllers base their award on the urgency of the work and on the fact that the city cannot do the work at the price quoted.

There has been keen competition for the supply of asphalt, and the decision of the Board of Control to award the contract to the Aztec Oil and Asphalt Refining Company has led to litigation. The bids submitted were: Texaco made by the Texas Company, $14.27 per ton; Aztec Company, $16.45; Asphalt and Supply Company, $15.75 (or $14.25 delivered in tank cars). The Warner Quinlan Asphalt Company and the Imperial Oil Company also sent in bids. On the Aztec Company expressing willingness to reduce the price to $15.50 delivered at the city yards, the Controllers decided to award them the contract for one year, with a recommendation that an additional contract for nine years, or a lesser period, be made with the same company at $15.50 a ton, provided the company agreed to construct a refinery in Montreal. The city is not required to buy the by-products of the company, and a deposit of $50,000 must be placed with the City Treasurer guaranteeing the company's fulfilment of the obligations. Controller Hebert recommended the Aztec tender on the ground that the material had given satisfaction in New York and that Montreal had the opportunity of securing a large industry. The legal representatives of the other bidders made vigorous protests, contending that all the firms were not being treated on an equal basis, and that everyone ought to have the chance of submitting propositions similar to that of the Aztec Company.

The Asphalt and Supply Company, in a communication to the Controllers, pointed out that their company have now in course of completion tankage for 100,000 barrels of Mexican asphaltic oils, etc., and further, that they have leased for a long period of years from the Harbor Commissioners of Montreal the necessary land for the erection of a complete asphalt refinery, together with a wharf on the Tarte Pier. The communication also outlined that they are the sole Canadian agents for Lord Cowdray, the head of Messrs. S. Pearson & Sons, Limited, who own and control vast oil fields in Mexico. They have a contract for a long term of years with the above firm for the delivery of whatever oil they require, which must be delivered in Montreal by contract. The Asphalt & Supply Company, Limited, were prepared to complete the asphalt refinery and to guarantee to supply asphalt for terms of two, five or ten years, at $15.75 per ton delivered at the city yards, or $14.25 per ton delivered at any city yard in tank cars. Following the awarding of the tender, Mr. Charles P. Dubuc, representing John Baker, Jr., of New York, the agent for the Texas Company, obtained an interim injunction against the contract, on the ground that the other tenderers were not allowed to meet the offer of the Aztec Company, that the contract was not awarded to the lowest bidder, that the price was altered after its submission, and that the contract with the Aztec Company is contingent upon a possible contract for a longer term. In this the petitioners complain that the city has exceeded its authority and that consequently the contract is null and void.

The cut herewith illustrates the cover of catalogue B1 just issued by the Armstrong Manufacturing Company, Waterloo, Iowa. This company have been engaged in the manufacture of a line of portable well boring and blast hole drilling machinery since 1867, and their new catalogue describes their latest types of machines for this work, with both gasoline engine and electric motor drives. Several interesting reports of drilling in various quarries are given in the catalogue, and they appear to show rather economical operation. The company make their gasoline engines complete. Several pages of the catalogue describe in detail the features of the engines specially built for blast hole drill work.

The illustration reproduced herewith shows the Barrett Manufacturing Company's exhibit in the Mines and Metallurgy Building at the Panama-Pacific Exhibition. This exhibit is a graphic illustration of the wonderful possibilities of coal tar, and it is well worth seeing. Coal tar at once suggests Tarvia, which is now being used on thousands of miles of macadam on this continent; and there are the Barrett specification roofs, which consist of tarred felt and pitch. The many other products are too numerous to mention.

The Barrett Manufacturing Company's exhibit at the Panama Pacific Exposition.

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Inspection on Building Construction

ONE'S attention is drawn to the position of responsibility of the architect or engineer in relation to his client by several recent decisions of the courts in which heavy damages have been awarded the client against the architect for faulty work on the part of the contractor. One can hardly question the correctness of the attitude of the courts in regard to this matter. While the architect may feel that there is a large element of injustice in holding him responsible for another's work, it must be conceded that the court is in a much better position to take an impartial attitude than an architect or engineer can be. Quite naturally, when a man retains an architect to look after his interests, and pays him a fee for this purpose which to the client nearly always seems a large one, and the results are not satisfactory, the architect is the one whom the client holds responsible—and certainly it is the duty of the architect to do everything possible to ensure that the work on the building shall be done properly.

It becomes necessary, then, for the architect, in order to protect himself from liability for damages, to take such steps as are necessary to obtain satisfactory construction. First, he must make certain that the plans and specifications have been prepared properly, which is a matter altogether in his own hands. Most of the recent actions for damages have been in cases of reinforced concrete buildings. An architect is taking a great risk in having concrete or steel framing plans prepared by any one except a man who he knows is competent to do such work. However, it is in the construction rather than in the design of such buildings that the fault has lain, and generally the architect has been blameworthy only because, through his neglecting to give proper inspection, the contractor has been allowed too much latitude in his work.

It devolves upon the architect or engineer, therefore, to employ such means of looking after the work that it will be impossible for even a dishonest contractor to do his work improperly. In the case of ordinary construction the general supervision as ordinarily given by the architect should prove sufficient. Nearly all the materials, such as stone, brick, lumber, and so forth, are either natural products or are manufactured before being brought to the building, and their quality can be ascertained by an ordinary examination. The quality of the workmanship also can be determined fairly well by an inspection after the work is done. In the case of steel work the architect is not taking any very big chances by not having the steel inspected at the rolling mills. The manufacturers aim to make a steel of uniform quality, and, while some rollings do not come within the limits of their standard, they vary so little from them that even the poorest steel rolled into structural shapes is quite good enough for use in ordinary structures. In larger and more important buildings, however, the steel should be inspected at the rolling mills, in the fabricating shops, and on the building.

In the case of concrete, both plain and reinforced, which has become so important in construction in recent years, the material is manufactured from its ingredients right on the work. The quality of the sand and stone can be determined by ordinary observation. The quality of the cement can be determined only by laboratory tests. While the cement manufacturers, like the steel manufacturers, aim to make a standard material, they are not so successful in coming within or close to the limits of their standard.

Some of the cement turned out by the factories is quite unfit for use; so that in all but the most unimportant work the cement should be tested.

Concrete is made in small batches, there being perhaps several thousand in an ordinary sized building. Any single batch, improperly mixed, could cause the collapse of a portion of the building. These batches are mixed and made by laborers who know nothing of the importance of having the proper proportions of ingredients. It is imperative, therefore, that a man be constantly at the machine to see that each batch is accurately proportioned and mixed. It is imperative also that a man be on the building where the concrete is being placed to see that the forms are constructed properly; that all dirt is kept cleaned off the forms and previously poured concrete; that the steel is properly placed and secured; that the concrete is puddled properly into the forms and around the steel—in short, to see that the concrete columns and beams are fabricated in an efficient manner.

It is evident that such inspection as this is quite outside the work meant by the term "supervision" as used by architects and engineers. Since it is extra work occasioned by the use of a special material, and work that would not be required by the ordinary forms of construction on which the scale of architects' fees has been based, it should be paid for by the owner.

In the case of inspection of steel work it is the practice of some architects to specify that the steel contractor shall pay the cost of the steel inspection, and to appoint one of the inspection companies to do the inspection. This could be done in the case of concrete construction also. The more satisfactory way, however, would be to make an addition to the regular commission, explaining to the owner why it is made and the necessity of it. In most cases an addition of one per cent. to the ordinary commission will be more than sufficient to cover the cost of such services.

If, in spite of this most careful provision for inspection, the building turns out to be faulty, and the design is correct, it must be on account, not only of dishonesty on the part of the contractor, but also of dishonesty, or negligence (which amounts to the same thing), on the part of the architect's own employees.

Awarding Municipal Contracts

IN Montreal there has been considerable trouble in connection with the city's awarding a contract for asphalt paving material to a firm other than the lowest tenderer, and, apart from the judgment given, the statements of the Judge have considerable interest as bearing on the motives which should actuate councils in awarding contracts.

Pointed criticism of the action of the Board of Control was made by Chief Justice Archibald when confirming the interim injunction entered by Charles P. Dubuc to restrain the city from making the contract for a year's supply of asphalt which, by a resolution of the Board of Control, had been awarded to the Aztec Oil and Asphalt Refining Company. While the petitioner, Dubuc, is the agent for John Baker, Jr., of New York, who had tendered for the supply of asphalt till the end of the current year at a lower figure than the Aztec Company, his injunction was entered as a ratepayer, alleging that the Board of Control had exceeded its jurisdiction, both in failing to award the original contract for six months' supply of asphalt to the lowest tenderer without showing valid reasons for rejecting the lowest tender, and also for making a subsequent agreement with the Aztec Company for a longer contract without giving other firms the opportunity to bid for this privilege.

His Lordship held that the petitioner had every right, as a ratepayer of Montreal, to take legal proceedings in this matter. In dealing with the rights and duties of municipal bodies, the Court emphasized the point that, when tenders had been called for, it was quite improper to pick out one tenderer and then make a private arrangement with him, not giving the other tenderers the same opportunity. If municipal business were to be conducted in this manner, the Chief Justice remarked, no respectable merchant would care to submit a tender, and the system would make all kinds of fraud and corruption possible. The Board of Commissioners had not in this case contracted by tender at all, and had granted something entirely outside of the Commissioners' power to grant. In considering the point that the Board of Control had proposed to extend the contract with the Aztec Company for a further period of eight years, provided the company should erect a refinery in Montreal, and that this would be recommended to the City Council, His Lordship dwelt on the inconvenience and expense that would be involved by the company if they were permitted to built the refinery in accordance with the contract and should perhaps be told later that the contract was illegal.

As regards the right of the Board of Control to reject the lowest tender, the Chief Justice held that such discretionary power could not legally be exercised unless the Board could show valid reason for not accepting the lowest tender.

The interim injunction having been confirmed, the case will be heard on its merits in the Superior Court; Arnold Wainwright, K.C., for the petitioner, F. H. Markey, K.C., for the Aztec Company, and P. E. Lamarche, K.C., for the city.

Building Our Cities

THE credit and progress of a city is based on the values created in the city, and there can be no doubt that its buildings are a city's most important asset. Our having paved streets, water-works, and other public utilities is only incidental to the fact that we have improved certain lands by erecting and establishing thereon our homes and places of business. Therefore the manner in which we build for and house and employ our people should be our first consideration.

In the upbuilding of our cities we find the enforcement of regulations governing the erection and maintenance of buildings a sadly overlooked quantity—simply because, however capable and conscientious a building inspector may be, he can enforce only what the people will submit to.

A building inspector may be, and usually is, an expert in his line, but should he exercise even ordinary courage in the performance of his duties he soon finds himself in conflict with a baker or a laundry man who happens to be in a particular situation by the accident of a few votes. Added to the other difficulties that we encounter is the fact that the courts have and do decree that the enforcement of all laws is distinctly and entirely within their jurisdiction and interpretation of the circumstances, and the writer can recall instances where Judges reserved their decision on the violating of a building by-law until they had viewed the premises, and then based their judgment on their personal knowledge of building construction—of which usually they are as innocent as a child is of the solar system. The Government is as responsible for the conditions under which our cities are built and our people are housed and employed as it is for the charters under which our cities are governed.

Many people will pay two dollars to keep a fifty-cent dog, and at the same time argue that it is not the city authorities' business even to suggest an improvement in the maintenance of buildings. The result of this is that insurance rates are excessive in all our western cities, and so it will continue until we can bring the public to realize the conditions we are creating.

The Purification of Sewage by Aeration

By R. O. Wynne-Roberts*

IN this article I will endeavor to describe the most recent method of treating sewage, which gives promise of great improvement on the measure of purification at present obtainable in the better managed sewage treatment works. In popular parlance, the new method consists in blowing air into the sewage until the carbonaceous and nitrogenous matters have not only been rendered innocuous and stable, but the residual sludge has also been converted into a good fertilizer.

At first glance the process may be thought simple and easily applied, but when it is examined carefully it will be found to involve some new problems which have not been encountered hitherto in this connection. It involves a bio-chemical investigation—for the purification of sewage is allied to biology and chemistry as well as physical operations, and in many respects it is not decided yet which constitutes the most important of these studies. Pneumatics and heating will be involved, as air must be supplied and distributed under the most advantageous conditions to promote thorough aeration, diffusion, and oxidation, while in rigorous climes in winter the air must be heated so as to produce the best result and maintain an equable temperature in the tanks. As cost enters prominently into this question, it will be necessary to have good management and efficiency to attain the maximum economy.

Aeration of sewage has been tried frequently during the last half-century, but the results obtained were indifferent. Indeed, many of those who experimented came to the conclusion that oxidation by this means was not practicable. Aeration of sewage has been tried under different conditions, and, while no tangible success has been met with, fresh light has been obtained, and step by step this process has been developed. One reason for the failures was the fact that the sewage, the effluent, or the filtrate was treated on a continuous flow, and the oxygen had not time to effect any appreciable changes. The prolonged experiments made by the Massachusetts State Board of Health at Lawrence have been the means of throwing light on many obscure changes, and latterly Messrs. Clark and Gage endeavoured to promote the oxidation of sewage by an abundant growth of green algae, which, as is well known, imparts oxygen to the polluted waters in which it is found.

Among the experiments made by Messrs. Clark and Gage the most interesting and instructive in this connection was one conducted in a small tank containing horizontal layers of roofing slates kept about one inch apart. Later on another experiment was made in the same tank with the slates placed vertically. The first was similar to Dibdin's slate beds, and the second similar to the colloidors in a hydraulytic tank or Martin's cellular tank. The primary object was to observe the effect of algae growth, combined with the blowing of air into the sewage, and the results were good.

Whilst researches were being made at Lawrence, Mass., others were being conducted at Manchester, Eng. The first experiment was made by inoculating sewage with a specific organism which has the power of precipitating iron as ferric hydroxide from solutions of iron salts. Dr. Gilbert Fowler and Capt. Mumford succeeded in clarifying and purifying sewage by this means when the sewage was aerated. The next development was made by Messrs. Ardern and Lockett, also at the Davyhulme Sewage Disposal Works, Manchester. Instead of trying to aerate a continuous stream of sewage or effluent, a sample was aerated until all the organic matter was oxidized, which took over a month to do—clearly indicating that before any tangible results from aeration can be secured certain conditions, which will be discussed later on, have to be obtained. After the sludge had been allowed to settle the clarified liquid was decanted and more fresh sewage was added. Air was again blown in until the mixture had been oxidized, which took place in less time than in the previous experiment. By repeating the operation of decanting the clarified liquid and adding more sewage until the quantity of sludge had accumulated to about twenty per cent. of the capacity of the vessel, it was found that the time required to purify the sewage diminished from five weeks to five hours.

Having succeeded in finding out what were the essential conditions of this process, Messrs. Ardern and Lockett tried the experiment on a larger scale—in casks. Fortunately the adjacent city of Salford had tanks already fitted with air pipes, so that it was a simple matter to try the aeration method on a still larger working scale. The results were good, as will be shown further on.

This method of sewage treatment has attracted great attention, and will be tried at Baltimore under the joint direction of the Baltimore Sewage Commission and the United States Health Department. It is stated that Milwaukee has retained the services of Dr. Gilbert Fowler to advise the authority on experiments to be made on these lines. Dr. Edward Bartow, Director of the State Water Survey of Illinois, made some interesting experiments on these lines which were described in the technical press. Several cities in Great Britain and the United States are trying or are about to try the process, and it is interesting to note that on my recommendation the City Commissioners of Regina have started investigations into the possibilities of the activated sludge process. The sewage in two tanks, each holding about five hundred gallons, is being aerated in Regina, one by air blowing and the other by air injection. The quantity of air is measured by circular orifices, and observations will be made as to temperature, chemical changes, and so forth. In due time the results of these experiments will be known, and they will be both instructive and valuable.

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* M. Inst. C.E., M. Can. Soc. C.E., M. Am. Soc. C.E.

Having described in a simple manner the progress of the development of sewage aeration, it will doubtless be interesting to describe some of the results obtained and the deductions to be made.

At Lawrence, Mass., where, as already explained, the main object was to study the effect of green algae and aeration on the sewage treated, it was found that the heavier the green growth the clearer was the aerated sewage.

At the commencement of the test the slate bed was aerated at the rate of 200,000 cubic feet of free air an hour for every million U. S. gallons. This was blown in for twenty-four hours, but as the experiment proceeded the air supply was reduced to 100,000 cubic feet an hour to each million gallons. Afterwards the slates were placed vertically one inch apart, and air at the rate of 150,000 cubic feet an hour for each million gallons was blown in for five hours. The greatest efficiency was obtained when the sewage was aerated for ten hours with air equivalent to 200,000 cubic feet to each million gallons an hour. The average reduction in free ammonia was about twenty per cent., and the reduction in Kjeldahl nitrogen and in oxygen consumed was about 56 and 61 per cent. respectively. The reduction in Kjeldahl nitrogen during the time when the gelatinous film on the slates had been re-established was more than five times as great as when the slate surfaces were comparatively clean. When air at the rate of 25,000 cubic feet for every million gallons an hour was used for five hours the reduction of Kjeldahl nitrogen was about 56 per cent.

Plant used in the experiments in connection with the aeration of sewage at Regina, Sask.

A heavy brownish gray growth of a gelatinous consistency on the slates appeared to collect the suspended matter mechanically, and also a large part of the colloidal matter in the sewage. The clarification effected was superior to all other processes with the exception of one in which large quantities of copperas and lime were used. The smallest average removal of total and organic matters in suspension was over 77 per cent., and even when only 25,000 cubic feet of air were used the average removal was 80 to 82 per cent.

Cost.—Assuming a depth of 5 feet of sewage, electric current at four cents a kilowatt and 25,000 cubic feet of air were used an hour for every million gallons, the treatment being continued for five hours. Messrs. Clarke and Gage estimated the cost of aeration at about $1.85 for every million U. S. gallons.

The effluent from the aerated sewage was filtered first at the rate of one million gallons an acre daily, and then the rate was increased gradually to ten million gallons an acre daily. The filter was ten feet deep of broken stone ranging from two-inch to one-inch. After maturing, it was attempted to operate the filter at such a rate that the filtrate would contain about 1.5 parts to every 100,000 of nitrates. It is interesting to note that when the filter was worked at the above maximum rate the nitrate amounted to 1.33 and 1.42 parts to a 100,000, while for all rates of flow from 1,000,000 to 10,000,000 gallons an acre daily during the year 1913 the average was 1.72 parts to a 100,000.

The results of the Lawrence experiments are very instructive when taken apart from the growth of green algae. Under Canadian conditions the cultivation of algae is practically out of the question, because filters and tanks are usually covered, and algae must have abundance of sunlight.

Reverting to the Manchester experiments, it is evident from the observations made by Messrs. Ardern and Lockett that the activated sludge when once produced by aeration must be kept in intimate contact with the sewage to secure the full value of the intensified oxidation which it is capable of effecting—or, in other words, the admixture of sludge and sewage must be thorough if the work of purification is to be accelerated and increased. The period of aeration after the process has been effectively established is dependent upon the strength of the sewage, and as Canadian sewage is more dilute than at Manchester it is probable that less time will be required to oxidize the organic matters, although it is possible that for the same quantity of carbonaceous and nitrogenous matters the quantity of air and the time taken to change them may be the same in Canada as in Manchester.

In the case of experiment 8 (a) at Manchester tests were made to ascertain the difference in the efficiency of ordinary contact as compared with thorough mixing of sludge and sewage. It was found that in the latter case the purification was much greater, as is shown below:—

Reduction in four hours' oxygen absorption, 14 per cent. superior.

Reduction of free ammonia, 42 per cent. superior.

Reduction of albumenoid ammonia, 22 per cent. superior.

Increase in nitrites and nitrates, 1100 per cent. superior.

The test made at Salford was started in June, 1914, and air was blown in under a pressure of two pounds. Copperas was added four times at the rate of sixteen grains to a gallon to accelerate the process. The purification was progressive as the quantity of activated sludge was gradually accumulated, for by October, 1914, when there was about twenty per cent. by volume of sludge in the tank the purification in two hours was 91 per cent. when based on the oxygen absorption figure.

In November last, with a blowing period of three hours, the results were as follows:—

Purification based on	Best	Worst	Average
	Percentage		
Albumenoid ammonia	77	78	76
Four hours' oxygen absorption	93	81	90

In this case the air was distributed through a large number of one-eighth-inch jets, and perhaps was not diffused as efficiently as if it had been blown in through porous plates. At the present time (May, 1915) the purification effected, based on the four-hour-oxygen-absorbed figure, with only one and one-half hours' blowing without chemicals and without filters, is from 90 to 94 per cent. These results appear to be practically automatic, seeing that Mr. W. H. Duckworth, the Manager, gets these results day in and day out with unfailing regularity. Porous plates are about to be installed, and it will be instructive to know what results will be obtained. The tank has a capacity of 25,000 gallons, and in October last received three charges a day. Another tank of similar capacity was inoculated in October, and no doubt by this time the process has been further enlarged. The Salford experiments were conducted by Mr. S. E. Melling and Mr. Duckworth.

There are certain conditions which appear to be essential in order to achieve the best results—for example, the air as it is blown through the sewage must be atomized or diffused so as to allow the sewage to dissolve as much atmospheric oxygen as possible. It will be conceived that, the larger the bubbles of air, the quicker they rise to the surface, and also the less surficial contact they have to part with the oxygen, whilst fine bubbles remain longer in the sewage and the oxygen is imparted to the sewage more effectively. Tests were made at Manchester to compare the results of air blown in through a tube and air diffused through a porous plate, with the following results:—

	Plain Tube	Diffuser	Percent increase in dissolved oxygen
At commencement	0.24	0.24	0.00
After 15 minutes	0.42	0.73	74
After 30 minutes	0.49	0.74	46
After 45 minutes	0.56	0.76	36
After 60 minutes	0.57	0.77	35
After 90 minutes	0.63	0.79	25

The temperature of the sewage has a material influence on the efficiency of the treatment, just as it has in the ordinary biological works at present in use. For example, in experiments made the percentages of ammonia oxidized at different temperatures were as follows:—

	After 3 hours' aeration	After 6 hours' aeration	After 9 hours' aeration
At 5° C. (41° F.)	1	2	6
At 15° C. (59° F.)	4	24	46
At 13° C. (55.4° F.)	2	14	22
At 20° C. (68° F.)	1	22	57
At 30° C. (86° F.)	1	10	26

The oxidation process was retarded when the temperature was constantly below 50° Fahr., whilst at 86° Fahr. the clarification was interfered with. It would appear that the sewage temperature should be maintained at about 60 deg. Fahr. This in itself is an important problem in Canada, because the temperature of raw sewage in some places tends to keep below 50 deg. Fahr. during the winter months, while the atmospheric temperature is often below zero Fahr., especially in the West. Consequently, it is apparent that the air must be warmed if the sewage temperature is to be maintained above 50 deg. Fahr.

Activated sludge is virtually the same in the Lawrence aerated slate bed, in well aerated perco-filters, and in the activated sludge process, and in each case performs practically the same functions.

The sludge resulting from the activated sludge process is quite inoffensive, dark brown in color (somewhat similar to that obtained at Lawrence), flocculent in character, low in specific gravity, but easily separated from water. The dried sludge at Manchester, Salford and Urbana had the following manurial constituents:—

	Manchester	Salford	Urbana	Salford ordinary sludge
	$	$	$	$
Nitrogen	4.6	3.75	6.30	1.20
Phosphate	2.6	2.10	3.31	1.10

It will be seen from the above that the fertilizing properties in activated sludge are much greater than in ordinary sewage sludge, and, furthermore, instead of being greasy, slimy and sticky, as in ordinary cases, it is granular, like sand.

Dr. Edward Bartow estimated that the manurial value of activated sludge produced at Urbana, Ill., was worth approximately $29 a ton of dried sludge; so that sewage sludge under these conditions would be an asset to the disposal works, instead of being a heavy liability from a financial viewpoint and an ever-accumulating mass of rubbish from the practical side.

Quantity of Air.—In the Manchester experiments the quantity of air blown in was at the rate of fifteen cubic feet an hour to a square foot of tank area. Dr. Bartow found that twelve cubic feet an hour sufficed.

Dr. Fowler expressed the opinion that the period of aeration, and therefore the quantity of air, depended not only on the strength of the sewage, but also on the degree of purification required.

Dr. Bartow found that after one hour's aeration a sample of supernatant water did not decolorize methylene blue for twelve days—showing that, even if complete nitrification had not been effected, the effluent was stable.

Mr. Wakeford stated that at Wakefield, England, with a very concentrated sewage containing a large quantity of trade refuse the present cost of treating the sewage with lime was $4.25 to a million gallons, whereas, considering the result of the aeration experiments in Wakefield, he could not see why the cost should not be reduced to $2.50.

Creosoted Blocks—A Promising Export Trade

ONE of the lines of lumber products for which there is a very promising future in the export trade, as well as in the domestic trade, is that of wood blocks for pavement purposes. Creosoted wood blocks laid under modern conditions are superior in wearing qualities to macadam, brick, asphalt, granite, or sandstone. As far back as 1901 the Metropolitan Street Railway Company of New York City made an experiment with creosoted wooden blocks for pavement between its tracks. A small area was laid, the wood being flanked at either end with granite, the material formerly used. The wood selected was long leaf yellow pine. There was a heavy truck traffic at the place where the experiment was made. At the part of the road where the trucks run with one wheel just outside the car rail the stresses on the pavement were very great, and the granite showed a rut in six months, requiring renewal almost annually. At the end of four years the wood, although showing a heavy rut, was still sound in position and good for at least one more year. The granite on either side had been renewed three times during the four years. The facts of this experiment are reported in United States Forest Circular No. 141.

Export Trade in Hardwood Flooring

Free Admission Into the United States Assisting Our Industry — History of U. S. Tariff Changes

WHEN, in 1913, the United States reduced the tariff on lumber there were some lumbermen who were doubtful as to whether it would have any appreciable effect upon the volume of Canadian exports. Experience has shown that, in respect of hardwood flooring, the abolition of the duty of $2.37½ for every 1,000 feet has increased our sales in the American market. The history of the placing of hardwood flooring on the free list is interesting, and the position of the wood in that category may perhaps be regarded as unintentional. When the schedules were issued it was found that hardwood flooring was omitted from paragraph 647, providing for the admission of certain classes of lumber free, and also from paragraph 176, which imposed a 15 per cent. duty on certain descriptions of manufactured lumber.

In these circumstances, the United States Deputy Collectors of Customs put hardwood flooring under paragraph 176, the result being that the duty, instead of being lowered, was considerably raised—in some instances more than trebled. The Seaman, Kent Company, Limited, of Meaford, Ont., Fort William, Ont., and Montreal, Que. promptly got into communication with the authorities at New York, Boston and Washington, and Mr. Kent and Mr. J. A. Bernard, the Montreal manager, visited these points and put their case before the authorities. The case they presented was very simple—it was that the Act was intended to reduce the duties, whereas the effect of putting hardwood flooring under paragraph 176 was to increase them enormously. The contention of the Customs authorities was that hardwood flooring, without being mentioned specifically, came within the definition of paragraph 176, objection being taken to the ploughing, and matching, boring, and dressing on the back (being in fact further manufactured than planed, tongued and grooved), these constituting, it was argued, processes of manufacture which rendered hardwood flooring liable to the duty of 15 per cent. The answer to this was that if the flooring was hollow-backed and bored it was manufactured for no further purpose than planed, tongued, and grooved lumber. The boring and the hollow-backing was done to satisfy a caprice of the public, and was not a real necessity. The boring was practically never used, and the hollow-back answered only the purpose of reducing the weight of the flooring for freight and of enabling the face to be distinguished from the back.

Considerable correspondence took place, and as a result a decision was come to. It was contained in a letter from the Treasury Department, Washington, addressed to the Collector of Customs, Ogdensburg, N.Y., as follows:—

Outline of the Tariff Situation

"The Department duly received your letters of the 7th and 9th ultimo relative to the proper classification of the lumber described in the list enclosed in your last mentioned communication, consisting of pieces of novelty siding, stair rails, base mouldings, sash rail, sash mortice, etc., samples of which lumber you forwarded under separate cover. As paragraph 647 provides for the free entry of sawed boards, plank, deals, and other lumber not further manufactured than sawed, planed, tongued and grooved, you inquire whether any of the samples submitted represent lumber further advanced than planed, tongued and grooved. The Board, in Abs. 13267 (T. D. 27685), held that certain so-called novelty siding which has been so shaped that one board overlapped the other was not subject to the additional duty provided in paragraph 195 of the Tariff Act of 1897 for tonguing and grooving. In a later decision, G. A. 5441 (T. D. 24719), the Board had before it for decision the proper classification of pieces of board ⅛ inch in thickness, and varying in width from 4 to 10 inches, and in length from 26 to 39 inches, the boards having been printed to represent cedar.

"The boards were assessed with duty as manufactures of wood under paragraph 208 of the Tariff Act of 1897. The Board held that the operation of printing did not constitute a manufacture of wood, for the reason that the boards had not been given a new name, character or use, but still remained wood, and as there was not provision for the importers that the wood was dutiable as sawed lumber under paragraph 195 of the said Act.

"The United States Circuit Court of Appeals for the second Circuit in T. D. 27385 affirmed the decision of the Board of U. S. General Appraisers that ordinary sawed lumber which had been subject to the fireproofing process which greatly increased its value was not, by reason of the process, removed from the provision in paragraph 195 of the Tariff Act of 1897 for sawed lumber.

"It will be noted, from the decision cited, that lumber may be advanced in value and conditions beyond that of lumber planed, sawed, tongued and grooved, and yet not be a manufacture of wood.

"While it is difficult to establish a well defined line of demarcation between lumber that is dutiable as manufactures of wood under paragraph 176 of the Tariff Act and lumber which falls within the provisions of the said Act, the Department is of the opinion, in view of the decisions cited, and giving due consideration to the purpose of the present Tariff Act, which is to reduce duties, that flooring, although in addition to being planed and tongued and grooved, it is ploughed on the under side to ensure a perfect fit to the board as flooring, is not excluded from the classification under paragraph 647. The Department is also of the opinion that the ordinary novelty siding, ordinary window parting strips, outside baseboards, ordinary siding, and other articles which are not moulded or beaded, are entitled to admission free of duty under paragraph 647.

"Articles such as sash rail, stair rail, crown moulding, signboard moulding, and similar articles, when beaded or moulded, are, in the opinion of the Department, properly dutiable as manufactures of wood at the rate of 15 per centum ad valorem under paragraph 176 of the Tariff Act."

Prior to the tariff revision of 1913 Canadian manufacturers had been sending a fair quantity of hardwood flooring into the eastern States, being able to compete, in times of good trade, owing to the favorable railway rates due to the geographical position of our mills. The great bulk of the American hardwood flooring comes from Michigan, and the long railway haul to the eastern States was a handicap when competing with Canadian mills. The imposition of the 15 per cent. duty would have more than counterbalanced any advantage we held owing to close proximity to markets, and would, in fact, have killed our export business. The placing on the free list, on the other hand, is a decided advantage, and has tended to increase the trade.

Addition to Post Office Building, Victoria

THE end of May saw the completion of the extensive additions to the Post Office building at Victoria, work on which was commenced in April of last year by The McAlpine Robertson Construction Company, of Vancouver, the successful tenderers. The additions comprise three storeys and a basement, covering an area 108 x 100 ft. The total cost of the work was about $150,000.

New wing of the Post Office Building, Victoria, B.C.

The construction is steel columns and beams, with wood joists. The external walls to the three street fronts—Humboldt, Courtney and Wharf—are of granite and cut Gabriola stone. The interior finish is of B. C. fir throughout, except that maple flooring is laid on the ground floor. Metal lath and hardwall plaster were used throughout. The stairs are of ornamental iron, with B. C. marble treads and landings. The main vestibule is finished in marble, the walls being lined to a height of nine feet. Two elevators are provided—one freight and one passenger.

Daily Cost-Data Sheets on Concrete Road Construction

DURING 1914 the Association of American Portland Cement Manufacturers gathered statistics covering the actual costs of a number of concrete roads and pavements. The costs obtained, according to the Engineering Record, were for labor, teaming, mechanical equipment, preparation of subgrade, and the mixing, placing, leveling and curing the concrete. In order to make olgical comparisons of costs for different sections of the country all "cost factors" that do not enter into the cost of the road "crust," such as earth and rock excavation, overhaul, stone sub-base, etc., were eliminated.

For ease of tabulation the cost data were divided into five major items: Labor, teaming, mechanical equipment, actual quantities used in constructing the concrete pavement, and various miscellaneous items.

The labor, exclusive of that used on mechanical equipment and teaming, is classified by location so that a comparison could be easily made between separate jobs regarding the efficient handling of men. The cost of teaming is sub-divided so that comparisons may be very readily made and under "Mechanical Equipment" the cost of plant, the interest and depreciation and the cost of labor and supplies have been given.

Economy dictates that the amounts of materials used should closely check with those theoretically required. The tabulation is arranged so that the cost of materials may be quickly lumped.

The miscellaneous items are naturally of small moment, but they have been added so that the figures may be conservative.

Approximately 1,500,000 sq. yds. of pavement were covered by this method of estimating distributed as indicated in the accompanying table.

In general contract work the methods of cost accounting are more or less haphazard and it would doubtless pay the road contractor to evolve a simple cost data scheme along the lines suggested.

Average Cost of Concrete Roads (1914)

State	Labor	Teaming	Mech Equip.	Materials	Misc.	Total Number	Sq. Yds
Connecticut.	$0.181	$0.142	$0.046	$0.752	$0.010	$1.088	200,066
Florida	0.108	0.028	0.003	0.838	0.014	0.991	13,000
Indiana	0.134	0.130	0.044	0.777	0.022	1.017	89,794
Illinois	0.136	0.101	0.033	0.528	0.016	0.814	17,970
Iowa	0.213	0.084	0.028	0.789	0.036	1.116	90,364
Kansas	0.396	.....	0.026	0.819	0.007	1.248	1,503
Kentucky	0.146	0.214	0.020	0.477	0.018	0.875	4,144
Maryland	0.111	0.128	0.065	0.716	0.057	1.077	36,211
Massachusetts	0.195	0.104	0.039	0.609	.....	0.947	26,200
Michigan	0.222	0.032	0.021	0.655	0.050	1.028	92,217
Mississippi	0.261	0.085	0.150	0.642	0.094	1.232	12,031
Missouri	0.209	0.133	0.027	0.656	0.059	1.045	22,376
New Haimpshire	0 126	0.097	0.032	0.907	.....	1.162	6,066
New Jersey	0.179	0.089	0.016	0.797	.....	1.091	8,355
New York	0.156	0.085	0.055	0.666	0.050	1.027	730,982
Ohio	0.181	0.091	0.067	0.642	0.009	0.946	58,968
Pennsylvania	0.279	0.091	0.031	0.742	.....	1.269	10,072
Texas	0.316	0.117	0.007	0.668	0.016	1.123	6,642
West Virginia	0.098	.....	0.060	0.912	.....	1.070	10,045
Wisconsin	0.188	0.110	0.045	0.682	0.023	1.033	61,879
Grand Average	0.183	0.105	0.040	0.719	0.046	1.058	*1,498,883

*Exclusive of profits and overhead charges.

Labor	No. Hrs.	Wages per Hour	Total Cost	Total Amount Handled	Cost per Cu. Yd.	Sq. Yd. Cost per Pavement
On Sand at Pit or Washer	..	.....				
On Sand at Work	3 1/3	.....	5.00	49 cu. yd.	$0.102	$0.0069
On Stone at Cars or Quarry	6 2/3	.....	10.00	99 cu. yd.	0.102	0.0138
On Stone at Work	..	.....	.....	....	.....	......
Wheeling Sand at Job	40	$0.175	7.00	49 cu. yd.	.....	0.0097
Wheeling Stone at Job	80	0.175	14.00	99 cu. yd.	.....	0.0194
On Mixer, Loader	30	0.175	5.25			0.0041
Engineman	10	0.30	3.00			0.0072
Fireman	10	0.20	2.00			0.0028
Chute or Bucket	..	.....	....			0.
Sub Grade before Mixer	10	0.175	1.75			0.0024
Sub Grade behind Mixer	..	.....	....			0.
Leveling Concrete	20	0.175	3.50			0.0048
Templet Men	20	0.175	3.50	124 cu. yd.		0.0048
Finishing Pavement	20	0.175	3.50	concrete	.....	0.0048
Forms, Joints and Reinforcement Men.	20	0.175	3.50			0.0048
Wetting Pavement	5	0.175	0.875			0.0012
Covering New Pavement	20	0.175	3.50			0.0048
Superintendent	10	0.750	7.50			0.0103
Watchmen	5	0.175	0.875			0.0012
Timekeeper	10	0.300	3.00			0.0041
Foremen	10	0.400	4.00			0.0055
Waterboy	10	0.150	1.50	....	. ..	0.0021
Engineman at Sand Washer	..	.....	.....	....	.....	......
Total Labor						$0.1147

Teaming	No. Trips	Cost per day	Total Cost	Av. Haul or Pump	Amount Hauled or Pumped	Cost per Cu. Yd. Mile or 1000 Gal. Mile	Cost per Cu. Yd. at Job	Amt. per Sq. Yd. Pavement	Cost per Sq. Yd. Pavement
Sand	16	$13.95	....	1,300 ft.	49 cu. yd.	....	....	....	0.0192
Stone, 2 trucks	33	28.78	....	1,300 ft.	99 cu. yd.	....	....	....	0.0397
Cement, 1 team	21	18.27	....	1,500 ft.	957 sacks	....	....	....	0.0252
Water	..	6.00	....	....	......	....	....	....	0.0083
Total teaming									$0.0924

Mechanical Equipment	Cost of Plant	Int and Deprec. of Plant 0.00154 x Cost	Cost of Labor	Cost of Supplies	Cost of Sq. Yd. Pavement
Steam Roller	$2,000	$3.08	$3.00	$3.00	$0.0125
Wheel Scraper	......	....	....	....	......
Scarifier	......	....	....	....	......
Pumps	600	0.93	3.00	3.00	0.0097
Mixer	1,850	2.85	5.00	....	......
Forms	.....	....	....	....	......
Barrows, Boxes, etc.	.....	....	....	....	......
Tractor	.....	....	....	....	......
2 Motor Trucks	7,100	11.13	6.00	6.00	0.0319
Sand or Gravel Washing Plant	.....	....	....	....	......
Stone Crushing Plant	.....	....	....	....	......
1 Hoist	7,000	10.78	7.00	8.00	0.0356
Total mechanical equipment					$0.0897

Quantities and cost of materials theoretically required and actually used on {410 lin ft. / 725 sq. yd.} of above road. Barrel of cement equals 3.8 cu. ft.

	Quantity	Per Unit Cost	Average Haul	Total Cost at Job Excl. of Haul	Cost per Sq. Yd. of Pavement
Theoretical:					
Cement	237 bbls.	$1.15 F.O.B. Cars	at job		
Sand	49 cu. yd.	1.63 F.O.B. Cars 0.77 cu. yd. Pit	at job		
Stone or gravel	99 cu. yd.	1.85 F.O.B. Cars 0.70 cu. yd. Pit	at job		
Actual:					
Cement	239.2 bbls.		1500	$275.08	$0.379
Sand	50 cu. yd.		1300	81.50	0.112
Stone or gravel	101 cu. yd.		1300	186.85	0.258
Steel or wooden joints	224 lin. ft.			10.08	0.014
Total materials					$0.763
Grand total					$1.0598

Notes:

The above report is taken as an average for the last seven working days: 410 linear feet per day, or 725 square yards of pavement.

Amount of water used cannot be determined.

Hauling of materials by two motor trucks and one wagon.

Cost of hoist is estimated.

Standard Form for Tabulation of Cost Data

State of ... ... Contract No. ... ... to ... ... Co.
Work Began or Completed ... ... Began or Finished Concrete ... ... Working Days
Cross Section 4¾ in.-6¾ in.-4¾ in.-16 ft. wide. Contractor ... ...
Equipment 10 Ton Roller (........) ... ... Traction Engines ... ... Wheel Scrapers
... ... Scarifier 1-2 H. P. Pump ... ... Sand Washing Plant Capacity ... ...
1 Hoist 2 Stone Trucks
Daily Report —Sept.7, 1914. ... ... Road Ass't

The Sooke Lake Water Supply for the City of Victoria, B. C.

Details of Dams at Sooke Lake and Humpback Reservoir—An 18-Mile Pipeline Brings Water to the City

By C. H. Rust*

THE first water-works system for Victoria was installed in 1868 by a private company, who pumped water from wells, which was delivered through wooden pipes, at a charge of three-quarters of a cent a gallon.

In 1872 the growth of the town necessitated a more adequate supply, and the city investigated the possibility of obtaining a supply from Elk Lake, which is situated in a north-easterly direction about five miles from the city. The official report made estimated that a supply of two and a half million gallons daily could be procured, and work towards obtaining water from this source was proceeded with. Until recently the water was procured from this lake by two pipe lines—one a gravity supply to the lower part of the city, the other carrying the water to the North Dairy Pumping Station, where it was pumped to Smith's Hill Reservoir. Three slow sand filter beds were established at Elk Lake. In recent years these have been worked beyond their capacity.

Owing to the rapid growth of the city, the level of the lake was lowered considerably, and the quality of the water impaired. In 1913 arrangements were made with the Esquimalt Water Works Company to procure a supply from them pending the completion of the Sooke Lake scheme, the city agreeing to pay that company six cents for every thousand gallons. The cost of procuring water from Elk Lake was two cents for every thousand gallons.

Dam at Humpback Reservoir.

In July, 1911, owing to the inadequate capacity of Elk Lake, the city decided to look for another source of supply, and various projects were considered. It was finally decided to utilize Sooke Lake, which lies about eighteen miles north-west of Victoria. The lake was subjected to a very careful investigation, including the study of rainfall, runoff, contour surveys, etc., and before the end of 1911 tenders were called for. The work of finding a proper grade for the flow line was one of great difficulty, owing to the dense forest and rocky bluffs.

Trestle carrying concrete flowline.

Sooke Lake is about four miles in length and half a mile across at its widest part. The area of the lake at low water, which is 555 ft. above sea level, is 978 acres. It was decided to construct a dam at the foot of the lake and raise the level of the water 12 ft. This gives a total area of 1,180 acres, the total watershed area being 31.33 square miles.

In the scheme for the ultimate development it is also proposed to utilize the Leech River watershed by building a dam in the stream and constructing a five-mile conduit to convey the water to Sooke Lake. When this is done a dam rising to a height of 45 ft. above the present low-water level of the lake is projected, and it is estimated that a daily flow of 100 second feet will be available, whilst the reservoir storage above low-water level will be 17,358,000,000 Imperial gallons. The initial project now under way by the use of a concrete dam at the outlet of the lake gives a reservoir capacity above low-water of 5,555,000,000 Imperial gallons.

The contract provided that the margin of Sooke Lake should be cleared to 15 ft. above low-water. This affected 300 acres of thick forest, which had to be cut down and burned. About two miles of waggon road along the east side of the lake had to be constructed, as the raising of the lake covered the existing road.

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*City Engineer and Water Commissioner, Victoria, B.C.

At the dam the intake channel is excavated 4 ft. below low-water, where an intake tower is constructed, controlled by seven sluice-gates. The gate openings are protected by screen cages. From the intake tower two lines of 40-inch riveted steel pipe are laid to convey the water to the screen house. Only one of these is in service at present. In the screen house is installed a set of twelve screens with a mesh of forty openings to the inch. Below these are the measuring weir and cascade steps. The screen house is of concrete, with a concrete roof, and a sink is provided for washing the screens.

Concrete pipeline near Humpback.

The dam is a composite structure, the west end being an earth embankment with a concrete core wall bonded into the natural rock. From the screen house to the east abutment an ogee weir section 200 ft. long is built, which is generally about 15 ft. above the foundation of natural rock.

Three alternative plans were considered in connection with the flow line, and the bids resulted in a decision to lay a reinforced concrete pipe line, the grade being one in one thousand.

The plans called for a pipe 40 inches in diameter with 3-inch thickness of walls, but it was finally decided by arrangement with the contractors, without any additional cost, to lay one of 42 inches. The concrete pipes are made in 4-ft. lengths. Fifty-four per cent. of this line is on curves. This will give a daily flow of approximately twenty million Imperial gallons.

A right-of-way 100 ft. wide was secured for the pipe lines, all trees were cut down, and also any tall trees outside the strip which in falling might damage the pipe. The pipe is not covered except in a deep cut at Humpback, where slides might occur.

At each 2,000-ft. point on the conduit line there is an open standpipe, and all inverted siphons, of which there are six, have waste outlets at the bottom controlled by six-inch gate valves. The pipe for siphons was made of 4-inch walls, with heavy steel reinforcement, varying in quantity according to the head. The deepest siphon is 600 ft. in length, and has a maximum head of 90 ft.

One of the difficulties in connection with this project was the securing of a reserve reservoir at the proper elevation and in fairly close proximity to the city. A suitable site was finally located at Goldstream at the Humpback Road, about 10¾ miles from Fountain Square in Victoria. This reservoir has a storage capacity of 136 million gallons, and covers an area of 33½ acres, from which it was necessary first to clear a very thick forest. The earth on a portion of the reservoir site is of black soil of a peaty nature, and this was covered with a 6-inch layer of clean sand and gravel.

The dam is about 560 ft. in length and 60 ft. in height, and contains about 9,000 cubic yards of masonry.

The gate house, with control valves and screens, is provided at the dam, and two cast-iron outlet pipes 34 inches in diameter are installed for the delivery to the pressure main. The water flows into the reservoir from the flow line over a series of steps, and there is also constructed a by-pass 24 inches in diameter whereby the water can be taken direct from the flowline to the pressure main without entering the reservoir. In addition to the by-pass, there is a pipe with a submerged outlet controlled by a butterfly valve.

From Humpback reservoir the water is delivered to the city through a 36-inch riveted steel pipe. It was not considered advisable to deliver the pipe direct to the city service system, as the pressure would be too great; so the water is allowed to overflow into Smith's Hill reservoir, which acts as a standpipe. This reservoir is situated at an elevation of 167 ft. below the water level of Humpback reservoir, or 213 ft. above sea level.

The pressure pipeline consists of two thicknesses of plate, 20,500 ft. of pipe using plates 5-16-in. in thickness, and 36,500 ft. of pipe using ⅜-in. plate. The pipe was made in sections 22 ft. long, and each pipe was dipped in an approved coating mixture. There are four concrete gate houses along the line. Inlet and outlet valves are also attached at frequent intervals. A Venturi meter with a recording apparatus is instal-

Pressure pipe at Station 53.

led in the concrete house below the Humpback dam, by which an accurate record is kept of the water passing through the pressure main.

The contract for this work was awarded originally to the Westholme Lumber Company. In April, 1913, after completing about 38 per cent. of the work, the Westholme Lumber Company abandoned the contract, and the work, with the exception of contracts being let for the construction of the concrete flow line and the pressure pipe lines, was carried out by a force account. This involved the construction of 27 miles of railway track on the concrete flow line with a gauge of 2 ft., the erection of a number of wooden trestles over the different canyons, and also reinforced concrete trestles and a steel bridge crossing Sooke River for carrying the pipe, and the construction of the dam at Sooke Lake and Humpback, also the completion of the clearing at Sooke Lake which had not been finished at the time the contractors abandoned the work.

A number of camps were erected at different points, and a large force of men were employed. The wages paid were $2.75 for eight hours. The men were charged one dollar a day for their board, and medical service was furnished by the city Medical Health Officer free of charge.

During the construction of this work, some parts of which were of a very hazardous nature, no fatal accidents occurred.

The contracts for the flow line and pressure pipe lines were awarded to the Pacific Lock Joint Pipe Company and the Burrard Engineering Company, respectively, and both these firms completed their work in a most satisfactory manner.

The following are a few data in connection with this work:—

Area of Sooke Lake at 665 ft. elev. city datum .	978 acres
After 12-ft. rise, area	1,180 acres
Land clearing around the lake	300 acres
Length of concrete flowline 42 inches in diameter	144,040 ft.

The first pipe was made 20th April; laying commenced 16th May, 1914; and the flowline was finished on 8th May, 1915.

Length of pressure pipeline, 36 inches in diameter, 56,677 ft.; manufacture of pipe was started in July, 1914; and laying was finished January, 1915.

Total quantities of earth excavated	180,342 cu. yds.
Total quantities of rock excavated	150,517 cu. yds.
Total cost of work to date (exclusive of land) ...	$1,720,000
Cost of land on the shores of Sooke Lake, the right-of-way for the concrete flowline and pressure pipelines, and land required for the construction of the Humpback Reservoir	$370,000
Approximate cost of land for the Sooke Lake watershed	$200,000

The population of the city is 50,000, and the daily consumption of water in winter averages 60 gallons per capita head; in summer, 80 gallons.

Mr. Wynn Meredith, representing Sanderson & Porter, was Consulting and Designing Engineer. Their Resident Engineer for the greater portion of the time was Mr. Boyd Ehle. Mr. J. L. Raymur was Water Commissioner until November, 1912, when Mr. C. H. Rust was appointed.

Economy in reinforced-concrete structures as compared with steel construction is computed at from 10 to 20 per cent. for building columns and floors by T. A. Watson in a paper presented before the Concrete Institute, London. He asserts further that reinforced concrete is nearly always the most suitable material for bridges up to at least 300 ft. in span. There are exceptions, but the mere question of cost of maintenance of a steel bridge is enough to condemn it; and this, coupled with the fact that the life of many wrought-iron bridges has been only about 65 years and that steel cannot be expected to last any longer, is a strong argument in favor of reinforced concrete. Apart, however, from the question of maintenance, the saving effected in cost of reinforced concrete over steel bridges is sufficient to justify its adoption, as much as 40 per cent. having been obtained in a bridge of 42-ft. span, 26 ft. wide between parapets.

A Simple Method of Applying Liquid Chlorine Under Pressure[*]

THERE are a number of water plants in the United States using pressure filters in which it would be desirable to use chlorine or hypochlorite of calcium as an aid to rendering the filtered water safe.

As there has been no very satisfactory method heretofore for thus treating the filtered water under pressure with liquid chlorine, engineers have resorted to the plan of applying the chlorine solution to the raw water, and, by using a considerable amount more than would be necessary otherwise, the bacterial purification of the filtered water can be maintained at the desired degree. However, this phase of water purification has been the principal reason why many engineers prefer open gravity filters to pressure filters, because with the former the chlorine solution can be discharged directly into the filtered effluent where it does the most effective work.

The following plan would seem to be satisfactory for accomplishing this result with pressure filters.

Assuming that we are using liquid chlorine instead of hypo-chlorite of calcium, the needle valve connecting the top of the liquid chlorine tank would be opened sufficiently to discharge the desired amount of chlorine gas to a unit of time. This chlorine gas would be conducted up through five or six feet of, say, 8-in. vertical pipe (concrete or terra-cotta), filled with broken pumice stone. At the top of the tank is sprayed the purified water, which, passing down through the broken stone, takes the chlorine gas into solution and discharges into a small tank of, say, twenty gallons capacity. This tank is maintained at a constant level by means of a float valve which controls the sprayed supply of purified water. The solution from the small tank is then pumped into the discharge main beyond the pressure filters by means of a reciprocating pump operated by either a water motor, electric motor, or a link connection with the main pumping engine, where this handles the entire supply, and thus the solution will be proportional to the rate of pumpage.

In most cases for small plants, where the amount of chlorine is, say, from one to four pounds to every million gallons, it is not important that the supply of chlorine be in direct ratio to the pumpage. It is only necessary that there be sufficient chlorine to sterilize properly the supply, and therefore the needle valve is set so that a given amount of chlorine can be discharged in the unit of time, say one day, and this can be readily effected by a few trials. The strength of the solution recommended should be so weak—say, 1 part in 10,000 or more—that the chlorine is all taken into solution, and hence will not materially injure the parts of the small pump.

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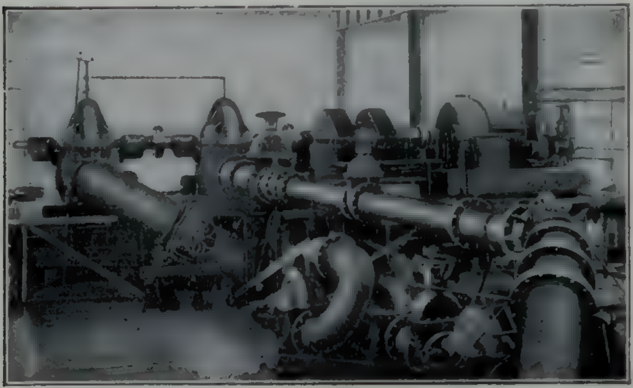
[*] Described by J. W. Ledoux, Chief Engineer, American Pipe and Construction Company, Philadelphia, Pa., in Engineering and Contracting.

Steam-Turbine-Driven Centrifugal Pumps in the Toronto Water-Works

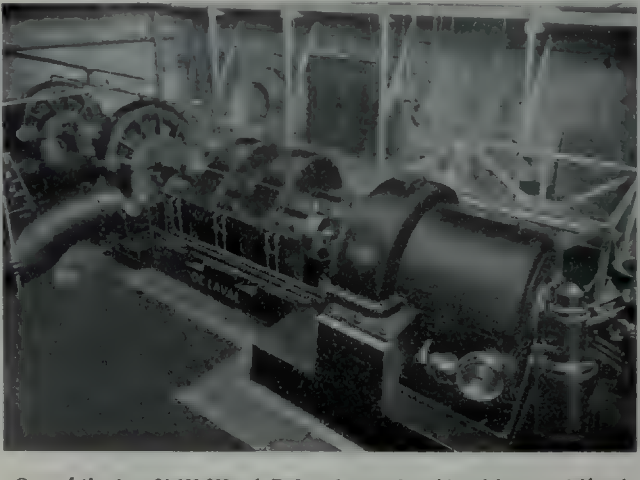
THE two pumping stations of the Toronto Waterworks epitomize, it might be said, the whole development of water-works pumping machinery in America, although at the present time some of the oldest units are being discarded in favor of more modern and economical apparatus. The John Street Pumping Station, which is the main station, supplies all sections south of College and Gerrard Streets, and delivers water to two large mains, one going to the reservoir in the northern part of the city at a pressure of 20 lbs., and the other to the centrifugal pumps in the High Level Pumping Station, about three miles north. It contains two 10,000,000-gallon horizontal compound Worthington duplex pumps, which, though installed about twenty-five years ago, are still used at certain periods. There are also two 15,000,000-gallon vertical triple-expansion high duty reciprocating pumping engines built after Allis-Chalmers designs by the John Inglis Company, of Toronto, installed eight and six years ago respectively, and four 13,500,000-gallon single-stage centrifugal pumps, operating against a head of 110 lbs. and driven at 750 r.p.m. by Canadian Westinghouse 1,500 h.p. motors. The latter pumps were installed about two years ago, and are operated with Niagara Falls power. There are also two 5,000,000-gallon centrifugal pumps directly connected to steam turbines, and two other pumps of the same capacity and make, directly connected to Westinghouse motors, all intended for high pressure fire service.


DeLaval centrifugal pumps in the John Street Station of the Toronto Waterworks System; capacity, 15,000,000 gals. a day.

With a view to increasing the capacity and economy of this station, specifications were issued in October, 1912, for machines of three different types: (a) a self-contained vertical triple-expansion fly-wheel plunger pumping engine with jacketed steam cylinders; (b) a centrifugal pump driven by a triple-expansion condensing engine, running at a speed of not over 350 r.p.m.; and (c) a centrifugal pump driven by steam turbine, the pump speed not to exceed 750 revolutions; the capacity in each case to be not less than 15,000,000 Imperial gallons of water for 24 hours against a pressure difference of 105 lbs. to a square inch between the suction and discharge mains. It was provided in the specification that a duty in excess of 100,000,000 foot lbs. to a thousand lbs. of saturated steam should be guaranteed, with a bonus of $1,500 for each million foot lbs. in excess of the guarantee, the total bonus not to exceed $10,000, and a penalty of $2,000 to be imposed for each million foot lbs. less than the guarantee, a deficiency of more than 5,000,000 foot lbs. below the guaranteed duty to render the pump subject to rejection. It was provided further that the steam pressure should be 150 lbs. gauge at the boiler, and that the steam should not contain more than 1½ per cent. of entrained water; also that the steam consumed by the auxiliary pumps, jackets, reheaters, air pumps, air compressors, boiler feed pumps, all of which were to be supplied by the contractor, was to be included in figuring the duty.

The decision as to the type and make of pump was made on the basis of net economy, or lowest cost to the gallon of water handled—that is, interest and depreciation charges on the cost of machinery, foundations and buildings and expenses for labor and supplies were taken into consideration as well as steam consumption. By requiring the contractor to supply the condensing equipment, and by charging him with the head consumed in friction in the condenser and with the steam required for operating the condenser pumps, full opportunity was given to the turbine manufacturer to take advantage of the better use which the steam turbine can make of high vacuums as compared with the reciprocating engine.

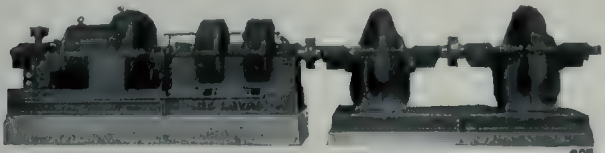
The contract was awarded to the Turbine Equipment Company, Limited, of Toronto, representing the DeLaval Steam Turbine Company, of Trenton, New Jersey, for a 1,400 h.p. steam turbine designed for a speed of 3,600 r.p.m., driving, by means of double helical speed-reducing gears, two 24-in. centrifugal pumps to operate at 600 r.p.m. The turbine is of the impulse pressure-stage type, and contains 14 stages. The gear is of the three-pinion bearing type, and is connected to the turbine and to the pump shaft by flexible couplings. Both turbine and gear are lubricated by a gravity system, an oil pump attached to the governor shaft forcing the oil through a cooler to an overhead tank, from which it runs to the bearings. The larger gear bearings and the pump bearings are ring oiled.


One of the two 24,000,000-gal. DeLaval geared turbine-driven centrifugal pumping units in the John Street Station.

The two pumps are of the single-stage double-suction type, and are operated in series—that is, the discharge from the first pump is carried to the suction of the second pump. The pumps are primed by a single steam ejector connected to the top of each pump casing.

The condenser, built by the C. H. Wheeler Manufacturing Company, is of the water-works type, in which the steam is inside the tubes and the water outside, and contains 1,500 sq. ft., made up of one-inch brass tubes each 7 ft. 2 ins. long. All of the water handled by the main pump passes through the condenser. The air pump is of the wet vacuum type, the steam end being of the ordinary slide-valve type, controlled by throttling governor. The steam for driving the air pump is taken from the main supply pipe between the separator and the steam turbine. As no oil is allowed to reach the inside of the turbine, the condensed steam is passed into the hot well and delivered to the boilers by a triplex, single-acting boiler feed pump driven by chains from the main pumping unit.

The acceptance test on this pump was run on November 30 and December 1, 1914, under the supervision of Prof. Robert W. Angus, of the University of Toronto, assisted by senior students from that institution. The contractor was represented by Mr. C. R. Waller, Chief Engineer of the DeLaval Steam Turbine Company, and the purchaser by Mr. McRae, Chief Engineer of the pumping station. Throughout the test, which was of twenty-four hours' duration, suction and discharge pressures, Venturi meter and condensate weight readings were taken every seven and a half minutes, while the steam main and nozzle pressures, vacuum, speed, and calorimeter readings were taken every fifteen minutes. All gauges were calibrated both before and after the trial and the scales examined and certified by a Government inspector. The barometric pressure during the test was obtained from the records of the Meteorological Office. The principal final results were as follows:



Rear view of 15,000,000-gal. turbine-driven pump.

Steam pressure in main, 148 lbs. per sq. in.

Steam pressure at turbine nozzles, 137.4 lbs. per sq. in.

Absolute condenser pressure, 1.06 in. of mercury.

Pressure difference on pump, 114.1 lbs. per sq. in.

Moisture in steam, 1.05 per cent.

Water delivered, Imperial gallons per 24 hours, 18,373,000.

Water horse-power, 1,016.4.

Duty developed per 1,000 lbs. of steam used, 130,499,000.

Duty guaranteed, 118,500,000.

Steam per water horse-power per hour-lbs., 15.18.

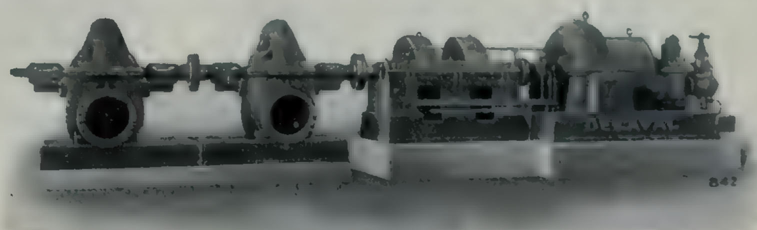
Since placing the first contract, two more units, each capable of delivering 24,000,000 Imperial gallons a day against 260 ft. head, have been ordered for the same station, from the Turbine Equipment Company, Limited; and two DeLaval pumps, one of 20,000,000 gallons capacity against 106 ft. head and one of 7,500,000 gallons capacity against 266 ft. head, have been ordered for the High Level Pumping Station.

The High Level Pumping Station is situated in the northern part of the city, about three miles in a straight line from the main pumping station, and supplies the district north of College Street to the Canadian Pacific Railroad tracks, and north of Gerrard Street in the east of the city. This pumping station, like the main station, exhibits more or less the history of pumping engines, as it contains a Holly vertical triple-expansion pumping engine, having a capacity of 6,000,000 gallons, and a similar pump built by the John Inglis Company, of Toronto. There are also two Blake-Knowles horizontal cross-compound pumps having a capacity of about 4,000,000 gallons. All of these pumps were installed about eight or ten years ago, and two years ago eight electrically-driven centrifugal pumps were installed. An extension is being made to this station for housing the two turbine-driven centrifugal pumps, and also two centrifugal pumps directly connected to Bellis-Morcom steam engines.

The DeLaval turbine-driven centrifugal pumps installed or under contract for the city of Toronto alone aggregate 90,500,000 gallons a day capacity, and 4,390 water horse-power. Although the first large DeLaval steam-turbine-driven centrifugal pump for municipal water-works service was installed by the DeLaval Steam Turbine Company only three years ago in the Ross Pumping Station, Pittsburgh, the total capacity of municipal water-works pumps built or contracted for by this concern now exceeds 600,000,000 gallons a day.

A "breathing pipe" was described at the recent American Waterworks Association Convention by W. F. Wilcox, of Ensley, Ala. Fluctuations in pumping pressure caused a regular heaving of a 50-in. steel pipe line, amounting to 5-32 in., although the movement to those who watched the "respiration" of the pipe appeared much greater. The alternate flattening and expansion of the line caused a crack in the ground above for a length of two miles. An air chamber to take up the surge was installed, and this remedied the trouble.

Erratum.—In our issue of May 26 we published, on page 567, an article descriptive of the new Immigration Building at Vancouver, B. C. We are indebted to Mr. Cole, engineer for Snider Brothers & Brethour, Limited, contractors, for the preparation of this article, and we regret the inadvertent omission of his name.



DeLaval Centrifugal Pumps driven by geared multi-stage turbine: capacity, 15,000,000 gals. a day.

Study of a Water Supply by Pumping for Concrete Road Construction

FREQUENTLY road builders are confronted with the difficulty of obtaining a suitable water supply in connection with concrete construction. In highway work the contractor cannot always arrange for an unfailing supply of water such as his brother contractor in the city may obtain, simply by entering into a contract with the municipality to pay a stated sum of money for such quantities of water as he may need, at the same time feeling sure that the supply required will always be available when needed, says a writer in Engineering and Contracting. In country highway work the contractor must, in nearly all cases, depend upon streams, ponds, lakes or wells for a water supply, and not infrequently must pump water several miles to the point where concrete is being mixed and placed. This has been the experience in concrete pavement construction on that portion of the old National Pike between Zanesville and Hebron, Ohio. Toward the end of the summer many of the streams from which water had been obtained ran very low or nearly dry, and water had to be pumped a distance of 2½ miles, in some cases over grades as great as 10 per cent. for a distance of 1,000 ft. Such problems as this require that careful layout of pipe lines and pumping plant facilities be planned and installed so that the cost of obtaining water may be kept at a minimum.

For the purpose of illustrating possible contingencies to be provided for in work of this kind, the accompanying sketch of pipe line requirements for water supply between the towns X and Y, shown by Fig. 1, has been prepared. Eight and one-half miles of 16-ft. concrete pavement, containing approximately 80,000 sq. yds., and lying between the towns mentioned, is presumed to be the piece of work that must be served by the pipe and pumping system to be used. Common labor is estimated at 22½ cts. an hour; pipefitter, 30 cts. an hour; pumping engineer, $3 a day. In the progress of construction all pipe will be hauled a distance of 8½ miles, as it will be taken off the cars at town X, and after completion of the work shipped from town Y.

Table 1.—Showing Total Head Against Which Water Must be Pumped

Line	Length of pipe, ft.	Friction head, ft.	Static head, ft.	Total head, ft.
A	12,560	189	100	289
B	12,560	189	150	339
C	9,920	149	50	199
D	13,840	208	120	328

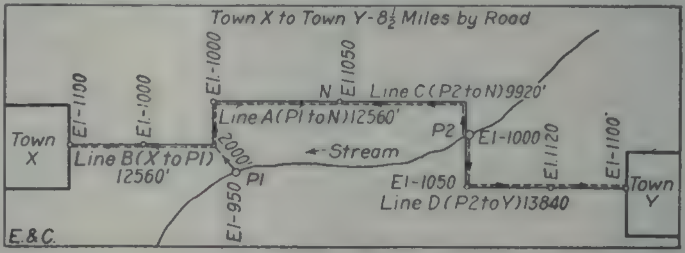
Presuming that concrete will be laid at the rate of about 500 sq. yds. a day, the job will require 213 calendar days for completion. This is based on the experience that not more than 75 per cent. of calendar days can be counted as working days, owing to holidays, Sundays, and interruptions caused by unfavorable weather. On the accompanying sketch, points P—1 and P—2 indicate consecutive positions of pump location. Table 1 shows the heads against which the water must be pumped.

From Table 1, one pump working against a head of 346 ft. or 150 lbs. is shown to be sufficient to deliver 15,000 gals. in a 10-hour day. Fifteen thousand feet of 2-in. pipe will be sufficient to supply water for the entire job. Taking up and relaying this pipe as the work progresses will involve the laying of 47,000 ft. of pipe. A conservative estimate of the time required to move the pump, set it up, and place it in running order, and to take up the pipe line A and place it in position to pipe line C, will be two days.

Two-inch Butt Weld pipe weighing 3.6 lbs. a lineal foot will cost, new, about 10 cts. a foot net, f.o.b. at place of purchase; 2-in. pipe with connections can be rented for 3 cts. a foot for the construction season, the contractor paying the freight both ways. Two-inch gate valves cost $3.00, 1-in. globe valves cost 75 cts., and T's from 2 to 1 in. cost 20 cts. each. Only gate valves should be used in the main 2-in. line.

An efficient pump would be a 3½ x 4-in. Deming, single-acting triplex plunger pump, outside guided and outside packed, delivering 25 gals. a minute when operating at 50 revolutions a minute, when fitted with 16 x 4-in. tight and loose pulleys. The approximate shipping weight for this pump is 1,100 lbs., and the cost is $125. To operate this pump against the maximum head equivalent to a pressure of 150 lbs. will require not less than a 5 h.p. gasoline engine. A gasoline engine of suitable type for this purpose can be bought for from $100 to $125. Belting, relief valve, and such connections as necessary would cost about $15.

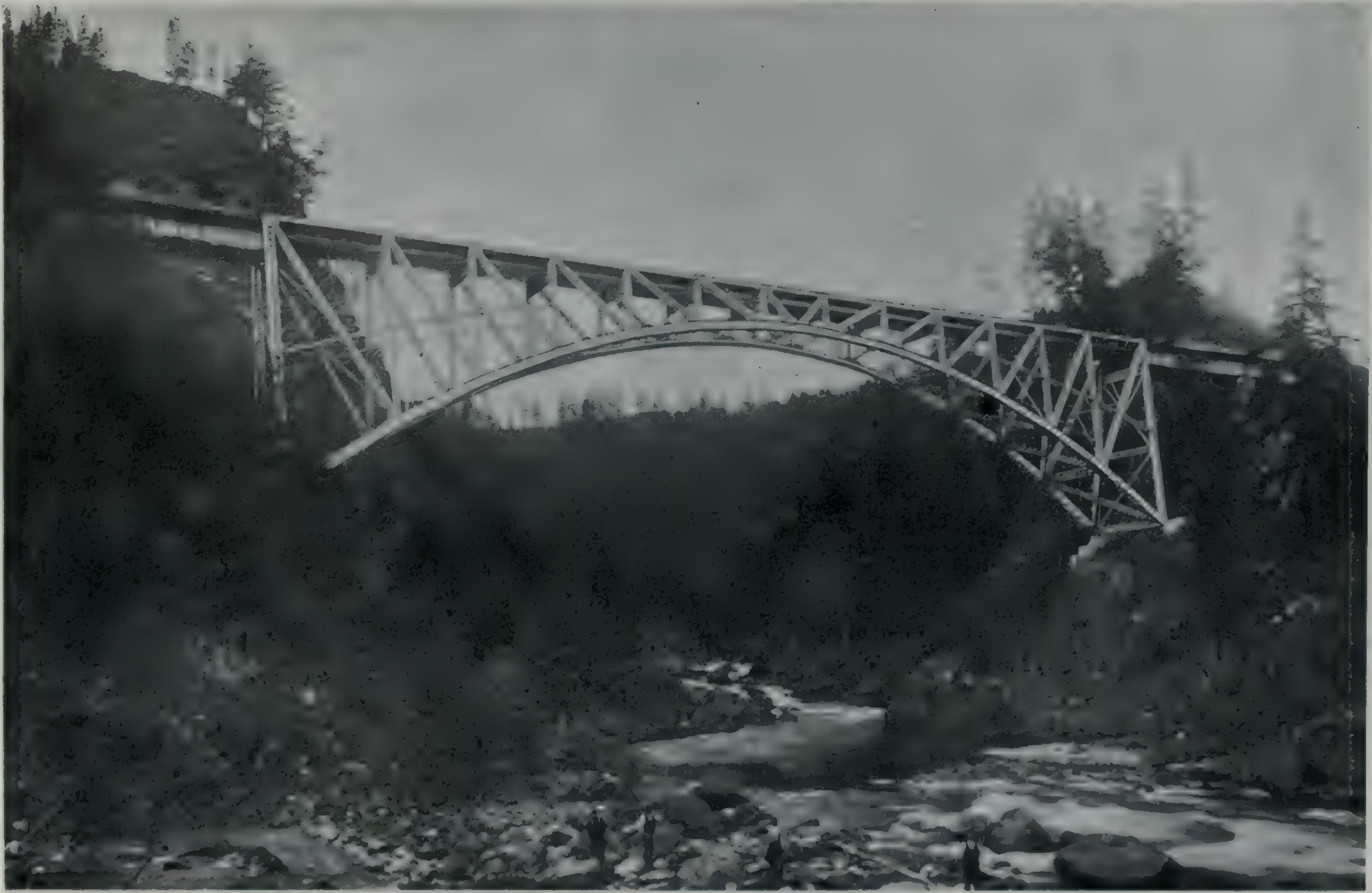
This equipment will supply 25 gals. a minute working against a head not exceeding 346 ft. (To the actual vertical head, 1.5 ft. must be added to each 100 ft. of pipe, to compensate for friction.) The estimate of pumping costs follows:



Plan of water supply.

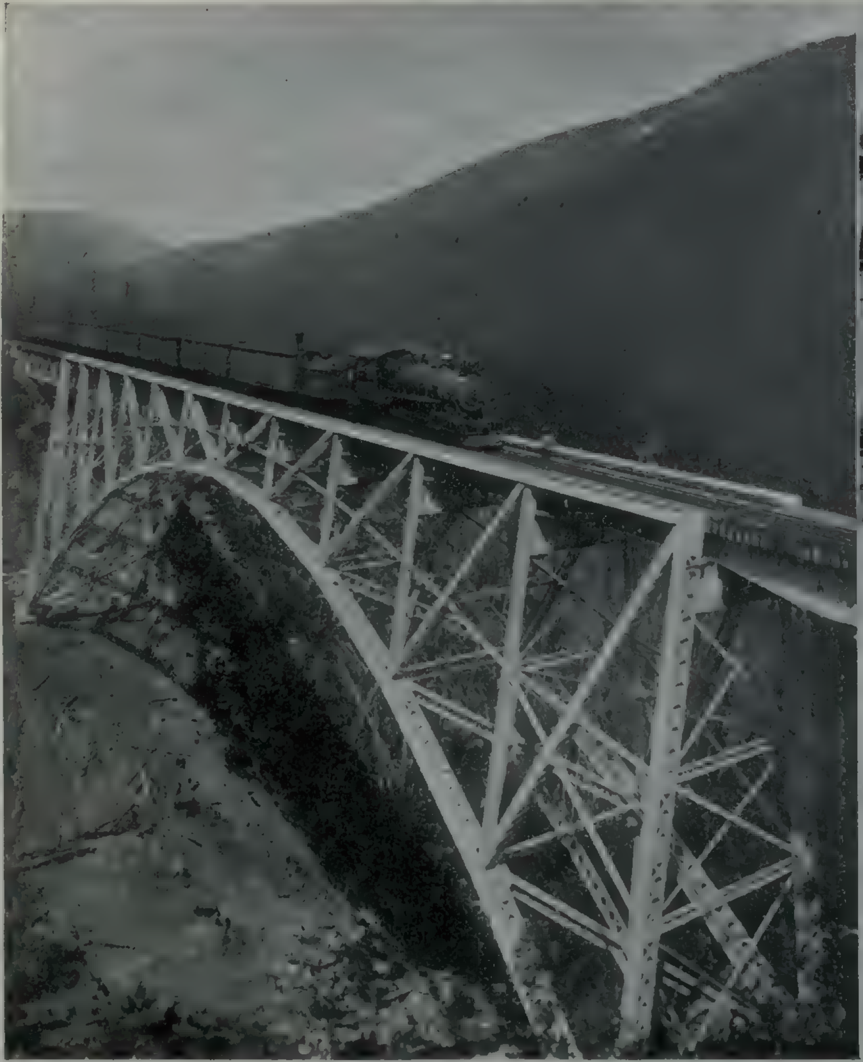
Cost of equipment to be credited to the job:	
10 2-in. gate valves, at $3	$ 30.00
50 1-in. globe valves, at 75c.	37.50
50 T's, 2 ins. to 1 in., at 20c.	10.00
400 ft. of hose, at 15c.	50.00
Deming single-acting triplex pump	125.00
4 h.p. gasoline engine	125.00
Belting relief valves, etc.	15.00
Incidental accessories	50.00
	$ 442.50
Charge 0.17 per cent. of equipment cost a day for depreciation and upkeep for 213 days	$ 163.85
15,000 ft. of 2-in. pipe, rental and freight, at $0.3¼ a foot	487.50
Labor for placing and removing pipe line and equipment:	
Hauling 15,000 ft. of pipe pumping equipment and accessories 8½ miles, 30 tons at 50c. a ton-mile	127.50
Laying and removing 47,000 ft. of pipe at 50c. a 100 ft.	235.00
Setting of pump and engine twice	20.00
Cost of pumping, including fuel and labor, say, 160 working days at $5	800.00
	$1,833.85
Add 10 per cent. for contingencies	183.39
Net cost of water for 80,000 sq. yds. of concrete pavement	$2,017.24
Net cost of water to a square yard of concrete pavement	$0.0252

Arch Bridge over the Salmon River, B.C.

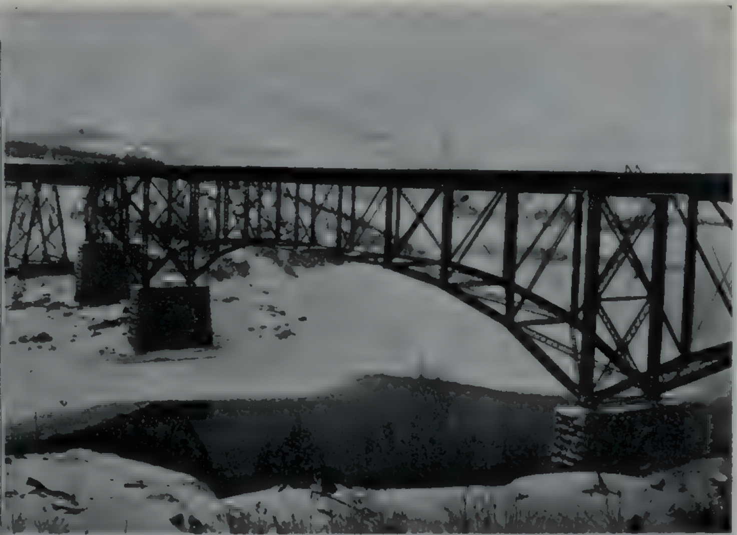


On the Canadian Pacific Railway, 137 miles east of Vancouver, B. C., is an arch bridge spanning the Salmon River. This bridge was built in 1893 by the Dominion Bridge Company. It has a span of 270 ft. and a rise of 50 ft., the depth being 60 ft. 3 ins. at the ends and 10 ft. 3 ins. at the centre. The trusses are 16 ft. apart at the centre line of the top chord but are placed in inclined planes on a 1 in 10 batter. The approaches consist of plate girder spans, making the total length of the bridge 400 ft. and the total weight of the structure 388 tons, the arch proper contributing 317 tons of this weight.

Three Types of Railroad Bridge Designs



The Surprise Creek arch bridge near Glacier, B. C.



The St. Maurice cantilever bridge.

The Three Rivers C. P. R. crossing.

The Surprise Creek arch is another Canadian Pacific bridge. It is located near Glacier, in the Selkirks, about 435 miles east of Vancouver. It was built in 1897, and has an unusual feature in its lack of symmetry, one pair of shoes being about 22 ft. lower than the other. The batter in this case is 1 in 8, the greater end depth 92 ft., the centre depth 16 ft., and the width between centre lines of top chords also 16 ft. The length is 290 ft. 4½ ins. between end pins; the weight of the arch is 520 tons, and the total weight, including the approach spans, 605 tons.

The St. Maurice cantilever bridge, also illustrated, was built in 1895 for the Great Northern Railway of Canada, now forming part of the Canadian Northern System. The nominal dimensions are: total length, 400 ft.; channel span, 250 ft., and width, 20 ft. The bridge is situated near Grand'Mere, Quebec. The steel in the cantilever weighs 305 tons, to which the trestle approach adds 64 tons.

The Three Rivers crossing by which the Canadian Pacific spans the St. Maurice on the main line from Montreal to Quebec consists of five 220 ft. spans built to the standard C. P. R. specifications of 1905. The centre to centre width is 18 ft. 6 ins., and the weight of each span is 380 tons.

Gauging the Flow in Sewers

IN designing new relief or intercepting sewers and sewage treatment works it is becoming a more common practice to gauge the flow of sewage in existing sewers. The measures adopted by a number of cities in sewer gauging were described recently by Engineering and Contracting as discussed before the Boston Society of Civil Engineers.

The Massachusetts State Board of Health uses a comparatively simple and inexpensive type of recording gauge. It is described substantially as follows by Edward Wright, Jr.

The gauge is used mainly for measuring sewage at disposal works where the sewage passes over a weir, although it has been used in the measurement of stream flow and in the measurement of the flow of trades and wastes where it is possible to install weirs.

The gauge, Fig. 1, consists of a copper float to which a rod and pencil are attached, and a cylindrical drum, which is caused to revolve by an ordinary clock mechanism. The float rod engages in two brackets which are provided with roller bearings. The paper upon which the diagram is indicated is wrapped around the drum and held in place by pins at the top and bottom and by rubber bands. The elevation of the starting point in relation to the crest of the weir is obtained by means of a hook gauge. The actual head on the weir is indicated.

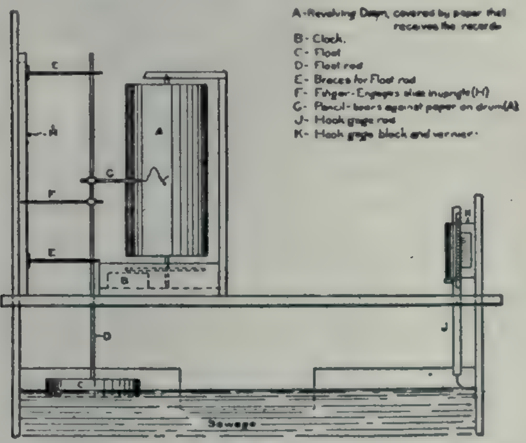

A-Revolving Drum, covered by paper that receives the records
B-Clock.
C-Float
D-Float rod
E-Braces for Float rod
F-Finger-Engages slot in upright (H)
G-Pencil-bears against paper on drum (A)
J-Hook gage rod
K-Hook gage block and vernier.
E
A
A
G
F
E
B
J
H
K
D
J
C
Sewage

Fig. 1.—Automatic gauge used by Massachusetts Board of Health.

The moving parts of the gauge are constructed of brass, and while corrosion starts in very rapidly, the gauge is so constructed that little or no difficulty ensues from this cause in its operation. The clock is so constructed as to run seven or eight days, and except when weather conditions interfere, the gauge will run without attention for this length of time.

Owing to the great amount of moisture which at times rises from the sewage in the tanks where the edge has been used, it has been found impossible to produce a pen-and-ink diagram, and, in fact, the moisture rising at certain sewage disposal works has been so great that the paper would be torn by the pencil, and to overcome this the very best quality of paper has been used.

The most remarkable feature about this gauge is that its cost, exclusive of the weir, is only about $25 or $30, which includes about $4 for the clock mechanism.

The gauge is very sensitive and, in fact, the effect of matters rising with gas in the sewage in the measuring tanks under the float has frequently been indicated. Most of the inaccuracy is due to the floating matters in the sewage, which displace the float and tend to clog the weir.

The flow of the sewage at the sewage disposal works at Marlboro, Mass., is measured by means of a trapezoidal or Cippoletti weir, placed in a channel leading to the sedimentation tanks. The sewage enters the screen chamber through a long cast-iron pipe siphon, passes through a coarse bar screen, and along a channel 7 ft. wide to a trapezoidal weir. The crest of this weir is 2 ft. long and the sides have a batter of 1 in 4. The crest of the weir is set 18 inches above the floor of the channel. The weir itself is made up of 6-in. by 3½-in. by ½-in. steel angles bolted together and set in concrete. The inner edge or crest is planed to a true, sharp edge. The depth of flow over the weir is measured either directly by hook gauge or rule, or by means of a recording gauge of the Bristol type. This description is by Frank A. Marston.

The original plan provided a cast-iron pipe well, with connection to the channel a few feet above the weir, in which the diaphragm was suspended. The recording gauge was fastened to the wall of the screen house. After operating the plant for several months it was found that considerable sludge and scum collected in the diaphragm well and proved to be objectionable, although it may not have had any serious effect on the diaphragm or on the operation of the recording gauge. Because of this collection of scum the diaphragm was removed from the well and was suspended in the channel itself, which arrangement has proved more satisfactory.

The average depth of flow is obtained from the circular chart by the use of a circular planimeter, and the quantity discharged by the trapezoidal weir is computed from the following formula:

$$Q = 3.366\ 2/3\ L\ h^{3/2}.$$

Q = quantity in cu. ft. per second.
L = length of crest of weir = 2 ft.
h = head on crest in feet.

In the design of the plant, the possibility of using a Venturi meter or some other form of measuring apparatus was considered, which would obviate the necessity of constructing an open channel with its attendant difficulties due to the deposition of solid matter, but it was felt that the city would not be justified in going to additional expense for this purpose.

The trapezoidal form of weir was chosen because of the great variation in flow to be measured. During dry weather single daily flows have been recorded as low as 150,000 gallons in twenty-four hours, and during the spring flow has reached as high as 2,300,000 gallons in twenty-four hours for a single day.

In studying the operation of the plant, it was found desirable to know the number of doses discharged by the automatic siphon from the dosing tank each day, and to obtain this information Mr. George A. Stacy, the Superintendent, installed another Bristol gauge in the dosing tank. This new gauge has operated in a more satisfactory manner than the other, perhaps partly due to the fact that the diaphragm is immersed in settled sewage. The charts obtained from this new gauge have been satisfactory and of considerable value. They show the rise and fall of the sewage level in the dosing tank, and are used not only as a check on the quantity of sewage, but especially to determine the quantity applied to the various filter beds.

After about one year's service, a new rubber diaphragm was installed in the screen chamber gauge. The old diaphragm appeared to have been attacked by something in the sewage, possibly sulphides, which partially rotted the rubber.

From the beginning of the operation of the recording gauge in the screen chamber, the attendant has kept daily readings of the depth of flow over the weir, measured directly at a point a short distance above the weir. The attendant was instructed to take these measurements at approximately 4 o'clock each afternoon, and from the data thus obtained it has been possible to check the readings of the recording gauge and to fill in the records for the periods that the gauge was out of commission.

A number of daily records were selected as being representative of the variations in flow, and from these a curve was plotted showing approximately the percentage which the 4 o'clock p.m. rate of flow is of the average for the entire day for varying rates of flow. By means of this curve the average daily flow was estimated, having as a basis a single measurement made at 4 o'clock in the afternoon. The results have been reasonably close and furnished a fair check on the working of the gate. The Marlboro sewerage system is largely on the separate plan, so that the variation in flow of sewage through the day is quite regular for certain average flows.

The experience with this type of recording gauge at Marlboro, although somewhat adverse, is not of a sufficiently serious nature to prevent the gauge being used in other places. The experience seems to point out, however, that it is very important that the gauge be thoroughly tested at the factory before it is installed, and that every precaution be taken to make sure that the tube connecting the diaphragm with the recording gauge be absolutely air tight. It is also of advantage to have the diaphragm immersed in as nearly clear water as possible, although the gauge has operated successfully in what might be called thick sludge. Apparently septic sewage has some action on the rubber of the diaphragm, requiring its renewal perhaps once a year, but this can be easily done by a man of average mechanical ability and should not be a source of serious trouble. Where a slight leak does occur in the pressure tube or in some other part of the mechanism, it is exceedingly hard to locate and much harder to remedy. On the whole, the records obtained in Marlboro have been very valuable, and experience seems to justify this type of instrument as against a more expensive type, under the conditions at this particular plant.

Some time ago Mr. Frank B. Sanborn had occasion to install a recording gauge for measuring the flow of the sewage of the city of Providence, R. I., and some features of the installation, here described, are somewhat unusual.

The flow of sewage is about 24,000,000 gals. a day, about one-tenth of which comes from a gravity system, the remainder being lifted 27 ft. at a point about 2,000 ft. from the disposal works.

The pumping plant consists of three Holly engines, each of which is connected with two centrifugal pumps, whose combined capacity is 43 million gallons a day.

The large size of these units necessitates a system of intermittent pumping during periods of small flow, as at night, or on Sunday, the sewage at such times being allowed to rise to a certain height in the large sewer leading to the pumping station, when the pumps are started, and operated until a certain low level is reached.

The discharge from the pumps, together with that from the gravity system, flows through an 88-in. conduit into a semi-circular open mixing channel, 150 ft. long and 16 ft. wide. In this channel are placed 20 slate baffles, set 6 ft. apart on alternate sides, and projecting 6 ins. beyond the centre line of the channel. From this channel the sewage flows directly to the four large sedimentation tanks.

Briefly, the conditions to be met with were as follows:

The location of the weir was limited to the mixing channel, in which the baffles caused a very great agitation of the sewage.

The weir had to be higher than the level of the sewage in the tanks, to be independent of variations in the method of operation.

It had to be as low as possible, to avoid increasing the work of the pumps.

The opening of the weir had to be sufficient to accommodate a flow of 120,000,000 gallons a day.

The recording device had to give an accurate record of the flow, without being so delicate as to be disturbed by momentary variations in height, due to currents in the mixing channel.

Owing to the sudden fluctuations caused by starting and stopping the pumps, the chart had to be in terms of volume rather than of height, so that the total flow each day could be determined by the use of the planimeter.

Since the weir would not correspond to the requirements of any formula, the actual flow had to be determined by experiment.

A location was chosen at the last baffle in the mixing channel, and a 10-ft. rectangular weir was placed at this point, having its crest 9 inches above the level of the sewage in the tanks, and 1 inch above the top of the baffle.

This greatly reduced the agitation in the mixing channel, but it was thought that the fall over the weir would give as good results as the former flow through the baffles.

By placing the weir at this location and height, no change was made in the conditions at the mouth of the 88-in. conduit leading from the pumps.

At a point 12 ft. up-stream a 3-in. pipe was built into the wall of the channel, 3 ins. lower than the crest of the weir. This pipe was carried into a large manhole, and another pipe was laid from the manhole to a 12-in. stand-pipe. The large amount of water in the manhole prevented the making of a wide line on the chart due to momentary fluctuations in height.

The weir was then calibrated by experiment, the flow being measured in the various tanks of the plant, while observations were made of the height at the weir.

Points were thus obtained at rates varying from two million to seventy-five million gallons a day, and a curve was plotted to show the flow at any given height.

The recording instrument selected was the weir-gauge made by the Hydro Manufacturing Company of Philadelphia. This instrument was intended to record height directly, and in order to get a record in terms of volume, the usual device was employed of introducing between the float and the recording pen a cam or spiral which should be designed according to the formula for this weir. An 8-in. float was placed in the standpipe, and connected by a cord to a counterweighted drum, having a diameter of 5 inches.

On one end of this drum was fastened a sheet-iron disc, 30 inches in diameter, and on the surface of this disc, raised on blocks ½ in. high, was placed a brass track, whose curve was such that the distance from the centre increased one-tenth of an inch for each million-gallon increase in the rate of flow.

On this track was made to travel a small wheel, whose axle was attached to the lower end of a vertical rod, on the upper end of which was fastened the pen-carriage of the recording device. By this means a chart was obtained which could be reduced to gallons per day by the use of an ordinary planimeter. After the device was in place it was repeatedly checked in amounts up to 7,000,000 gallons, by actual measurement in the sedimentation tanks.

The engineering department of Newton, Mass., maintained sewer gauging apparatus at three of the connections of its sanitary sewer system with the metropolitan trunk sewer near the Charles River for a period of about a year during 1902 and 1903. These gauges are described as follows by Edwin H. Rogers:

The gauges were in the form of a weir, with apparatus to measure the depth of flow, consisting of a float and a connection therefrom which registered the rise and fall of the sewage on a perpendicular revolving drum operated by clockwork. No reduction gear was used, the actual rise and fall being recorded. The drums revolved once a week, requiring the renewal of the record chart every seven days.

The weirs were located in manholes of the sanitary sewers, and as their crests were raised from 1 to 2 ft. above the invert of the sewers, they proved more or less of an obstacle to the discharge of the solid matter in the sewage, retaining a considerable amount of sludge which had to be frequently removed.

Considerable difficulty was experienced in the maintenance of the clocks, principally on account of the dampness which rusted out the hair-springs in their escapements and also tended to promote the growth of mildew in the works in such quantities as to stop them within a month, even though they were entirely enclosed in brass boxes.

The results obtained were in the main satisfactory, owing principally to the care exercised to keep the apparatus in suitable working condition.

In 1906 to 1908 attempts were made by the department to record the flow in three of the main surface drains of its separate sewer system for the purpose of obtaining data relative to the run-off of storm water. In one drain a weir was constructed with automatic registering apparatus, but was a failure, owing to the sand and other wash from the streets interfering with the operation of the apparatus.

In another instance a float was installed in a chamber beside the drain and connected with the invert of the drain by an inverted siphon.

Owing to the amount of rise and fall of the flow it was necessary to use reduction apparatus between the float and the register chart.

This method of measuring the flow could not be considered a success, partly on account of the pipe connection between the drain and the chamber being clogged with sand and other materials, and partly from the difficulay of calibrating the chart for different depths of flow in the drain. The drain was laid on a 3 per cent grade and the flow through it caused apparent fluctuations in the float chamber which vitiated the attempts to obtain accurate records.

The third installation consisted of a float in a 12-ft. by 6-ft. drain, connected by reduction gear with a clockwork recording dial. It was found advisable to use a boat-shaped float of 4-in. plank, some 18 ins. wide and 8 ft. long, hinged by a 10-ft. rod to the top of the drain, which floated smoothly and did not collect rubbish. The clockwork was housed outside of the drain in the open air, thus avoiding difficulty in its maintenance. This apparatus was in operation with fairly successful results for several months.

A self-registering rain gauge was maintained in conjunction with these gaugings of the drains.

The element of time being an important factor in the derivation of run-off data, it is important that the clocks in the apparatus be closely synchronized, a serious problem, owing to environment and climatic changes, unless a system of electric clocks is employed.

After a considerable sum of money had been expended, it was decided that the results obtained did not appear to justify the fufther expense of maintenance and operation and the gaugings were discontinued.

Various methods have been employed for the measurement of the flow in Brooklyn sewers, and these methods are here described by Edwin J. Fort.

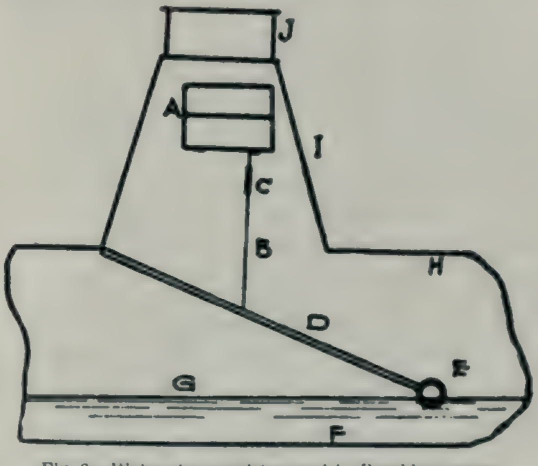


Fig. 2.—Water stage register used in Brooklyn sewers.

Of the several methods employed at Brooklyn the most successful have been the use of the self-recording water stage register and the knife-edge weir.

The self-recording water stage register referred to may be used in all sizes of sewers for domestic flow or storm water run-off. In using this method the hydraulic gradient of the flow is obtained by observation and measurement, as is also the cross-sectional area of the sewer for the depth of flow observed. The value of n, in Kutter's formula, is determined mainly by the exercise of judgment on the part of an experienced observer, in the absence of experimental data. Kutter's formula for velocity is then applied, and by this means the quantity of flow is obtained.

Weir measurements are used in exceptional cases, especially where the entire flow of a drainage area or district can be weired in the out-fall trunk sewer.

The gauge and weir, the description of which follows, have been used in experimental work of this character in a number of drainage areas in this borough, and the results have been quite satisfactory.

Objection may be made that such an estimation of the value of n is liable to considerable error, but even if this were true (of course the greatest care should be taken to estimate the value of n as correctly as our available information permits), the same value is also used in designing sewers, so that any such error would be compensated in the final result.

The equipment used to measure the flow in sewers from the run-off produced by rainfall, consists of two Frieze self-registering water stage registers, and one vertical drum sewer gauge designed by this bureau. Vertical flood sticks or maximum depth of water gauges are also used to determine the maximum flood wave for a given storm.

Figure 2 shows diagrammatically: (A) A water stage register placed on a shelf in an indicated manhole; (B) a copper ribbon passing over the transmission gear of the register; (C) a lead counterweight attached to one end of the ribbon to keep it in tension so that the motion of the float arm will be transmitted to the recording device; (D) an adjustable float arm to which the other end of the ribbon is attached; (E) a copper ball float; (F) represents the inner bottom of a 42-inch sewer; (G) the normal flow line; (H) the inner top of sewer; (I) the manhole, and (J) the head.

The gauges are calibrated by raising the float 0.5 ft. at a time, and noting the value of the movement on the recording device. In this way calibration curves and scales are drawn.

When installing a gauge, the sewer in which it is to be placed is carefully measured, and a curve plotted showing the value of Q for all depths of flow. The gauge is then placed in position, the ribbon attached to the float arm and counter-weight, a blank record placed on the drum and the pen inked and pressed down on the record ready for recording. The ball float is then placed 0.5 ft. from the bottom of the sewer, the position of the pen and the elevation of the float ball being recorded on the blank record; the float ball is raised 5.0 ft. more and the new position of the pen and elevation float recorded. This operation is repeated until the float ball has reached the inner top of the sewer. The elevations are then corrected for the depth of water required to float the ball. By comparing this record with the Q curve, a scale is made so that it will give the value of Q for any position of the pen on the record.

The height of a flood wave is shown on a well sanded vertical flood stick by the sand being washed off as high as the water rises. This gives a very sharp line for the height of the wave, and is of advantage in determining the slope.

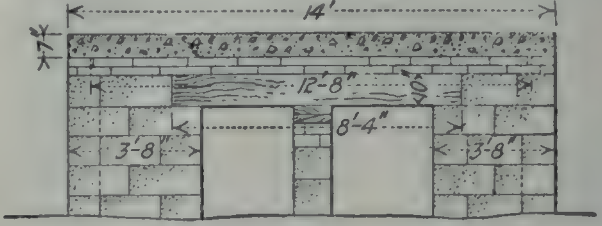
The use of the weir is well illustrated by a concrete example; one of our problems was to determine the infiltration and the maximum and minimum flow of sewage for a large district, the population of which was about 177,671.

To obtain the desired information a weir was used, and the flow automatically gauged during the entire day and night for each day of the week.

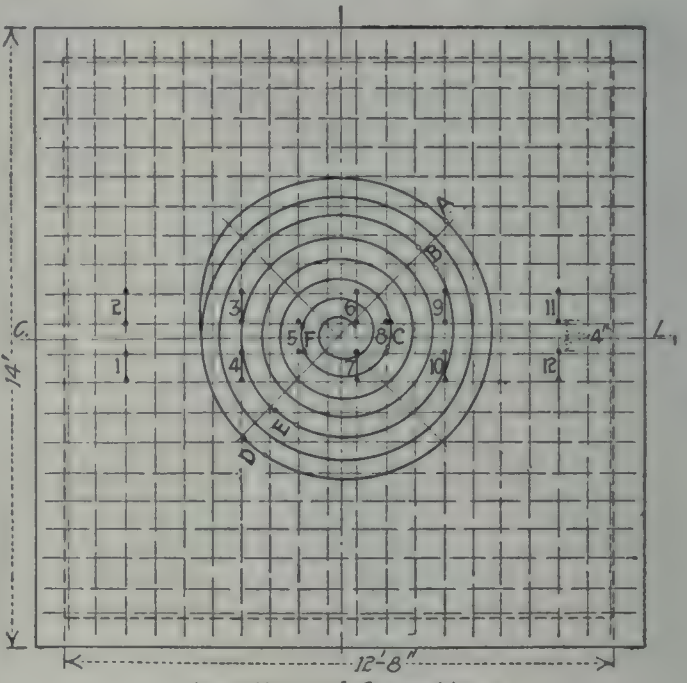
The weir used was located in the out-fall sewer, or outlet flume, and belonged to the sharp-crested type, with end contractions suppressed. The crest length measured 25.84 ft., and the height 2.17 ft. The head on the crest when not affected by storm or snow water varied from .362 ft. at 4.30 a.m. on Fridays to .543 ft. at 3.05 p.m. on Tuesdays.

The device for recording the heads consisted of an automatic water stage register placed over a "basin" pit located just outside of the channel and about 16 ft. up-stream from the weir crest. The pit was connected with the flume by means of a 3-in. iron pipe 3 ft. long, laid on the floor and perpendicular to the side of the approaching channel. The zero for the register was determined by means of a hook gauge and a Y level. The correction for slack motion of the register was determined by the hook gauge to be ½ of 1 per cent.

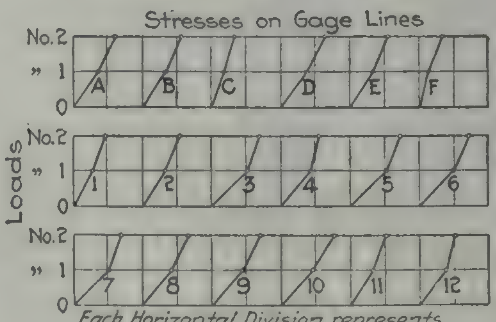
Bazin's formula, Q= MLD √2GD, for suppressed weirs with velocity of approach, was used to plot the results of the investigation. It is suggested, however, that Hamilton Smith's formula, $Q = 3.29\ LH^{3/2}$, for weirs of great lengths, may give more accurate results.



Method of Supporting Slab



Location of Gage Lines



Each Horizontal Division represents 5,000 lb. per sq. in.

Load No. 1 = 382 lb. per sq. ft

" " 2 = 475 lb " " "

Log of test on special slab.

The total mean flow for 24 hours as indicated by the gauge records was 18,123,000 gals. The total amount of water supplied to the district gauge, according to information received from the Water Department, was 17,767,000 gals. The total amount of ground water (infiltration) a day was 356,000 gals.

Test of a Peculiarly Designed Concrete Slab

THE accompanying diagram gives the result of one test of a series made at Minneapolis, Minn., on a reinforced-concrete slab in which an ordinary two-way reinforcement is supplemented by a spiral of reinforcement lying on the crossrods, described by Engineering News. In building the test slab, four L-shaped corner footings were set up of cement blocks bounded with a rich mortar. A timber beam was then set across the openings, and two courses of brickwork laid all around on the beams and stonework. Upon this brickwork the slab was cast. Subsequently, piers were put in under the centre of each wooden beam. The concrete was a 1:2:4 mix, of which two cylinders averaged 1,775 lbs. per sq. in. at the end of 153 days.

The reinforcement consisted of a ⅜-in. round spiral placed on a two-way reinforcement of ⅜-in. round rods spaced 8 in. c. to c. The spiral was 6 ft. 8 in. in diameter and was held in position by clamping it to two ⅞-in. channels which were so punched as to serve as spacer bars. The lower belt of rods was placed ⅜ in. clear of the forms in the centre of the span and ⅜ in. clear of the supports, the upper belt of rods resting directly on the lower belt.

Gauge points (12 in. c. to c.) were placed as shown in the diagram, those on the straight rods being in the lower belt. Test loads of pig iron were applied 109 days after the slab was cast. The steel deformation shown in the diagram were measured with Berry extensometers.

Personal Mention

Mr. Sydney Comber, building designer, has removed his offices from Greene Avenue, Westmount, to 304-305 Coronation Building, corner of St. Catherine and Bishop Streets, Montreal.

Mr. J. B. Whitney, formerly connected with the Ontario Flexotile Company, Toronto, has been appointed Manager of the Montreal Flexotile Floor Company, 10 Hospital Street, Montreal.

Mr. T. H. White, Chief Engineer, and Mr. M. H. McLeod, General Superintendent, of the Canadian Northern Railway's western lines, have returned to Vancouver from Edmonton.

Messrs. R. S. and W. S. Lea, New Birks Building, Montreal, have been appointed Consulting Engineers in connection with the projected construction of a storage dam at Chatham, New Brunswick.

Mr. A. L. H. Renaud, Manager of Lecky & Collis, Limited, Montreal, has obtained a lieutenant's commission in the 57th Regiment; while Mr. F. G. M. Williams, sanitary engineer, of Montreal, is also going to the front.

Mr. A. S. Fairn, who was for several years in the service of the C. P. R. as engineer in the construction of the irrigation block in the Calgary district, has been granted a commission in the 25th King's Own Scottish Borderers, in which regiment he enlisted at the beginning of the War.

Mr. Edward C. Johnstone has been invited to join the Toronto staff of the Dominion Paint Works, Limited. Mr. Johnstone will relieve Mr. Warner, the eastern representative of the company, of that part of the business pertaining to the repainting of factories, office buildings, etc., which has grown very fast.

At Taber, Alta., the death occurred recently of Mr. H. Y. Parker, formerly City Engineer of Cranbrook, B. C. The late Mr. Parker was born at Norwich, N. Y., in 1876, and graduated as a civil engineer from Cornell University. He went west in 1905, and acted as City Engineer for Cranbrook from 1910 to 1913.

The retirement is announced of Mr. J. H. Kennedy, Chief Engineer of Construction for the Vancouver, Victoria and Eastern Railway. Mr. Kennedy has had a long connection with the Great Northern Railway, and the completion of the Vancouver, Victoria and Eastern from Midway to Hope relieves him of further duties.

Mr. R. O. Wynne-Roberts, an article from whose pen appears in this issue, recently resigned his position as Consulting Engineer to the city of Regina. Mr. Wynne-Roberts was a visitor at the office of The Contract Record last week. We understand that he intends visiting cities in Eastern Canada and the States, and it is possible that he may then proceed to Europe.

Mr. Henry Hadley, B.Sc., the City Engineer of Verdun, Que., has resigned, with a view to going to the front. He hopes to obtain a commission in the 5th Mounted Rifles. Mr. Hadley was a McGill student, and in addition to other engineering work has taken part in surveying for the Grand Trunk Railway. During his term of office with the Verdun Council the district has grown at a very rapid rate, and some large civic works have been carried out under his direction.

Mr. R. S. Lea, of the firm of R. S. & W. S. Lea, consulting engineers, New Birks Building, Montreal, returned recently from a visit to Great Britain and other parts of Europe. He was in Austria when the war broke out, and was detained there for two months, when he and others were exchanged for Austrian subjects in Great Britain. While in the Old Country Mr. Lea was consulted in connection with various power developments and other work in Spain under the control of a large English company operating in that country. He also took advantage of the opportunity to visit a number of the most important water-works and sewerage systems in England, and was afforded special facilities by Government and other officials for making a thorough investigation of the methods of stream pollution prevention and the latest ideas relating to the treatment and disposal of sewage, with particular reference to their employment under conditions prevailing in Canada.

Brockville town officials, including Mr. C. R. Deacon, Chairman of the Water and Light Commission, Mr. E. J. Phillips, Manager, and Mr. G. H. Bryson, Town Engineer, have returned from a visit to several United States cities, where they inspected filtration plants of the types under consideration for use at Brockville. Tenders have been submitted to the Brockville Water-works Department for rapid sand filters, and the officials visited plants of this type at Niagara, N. Y., Erie and Phoenixville, Pa., and Trenton, N. J. They were successful in obtaining valuable information in connection with the operation of these plants.

Major T. A. Starkey, of McGill University, commanding the "A" Sanitary Section, has a very high opinion of the force which is going to France as a sanitary corps. The work will be of a semi-scientific nature, such as protecting the water supply and looking after general sanitation. Practically all the men have had a technical training; most of the privates have gone through a university course, and they include forestry engineers, architects, civil engineers, sanitary engineers, and a bacteriologist. "I have a company of trained men who can do anything, from looking after sanitation to installing a sewage plant or designing and building a bridge," said Major Starkey. "The men have been selected with care, and so many McGill students have offered, from the various branches of scientific work, that I do not think so well qualified a corps of military men has ever left Canada."

Mainly Constructional

East and West From Coast to Coast

On account of difficulties in securing a site for the new sewage disposal plant at Peterborough, Ont., it is unlikely that work will be commenced on the construction of the plant for some time.

Work on the extension of the Dominion Government wharf at White Rock, B. C., will be commenced immediately by the Fraser River Pile Driving Company. The wharf will be completed in about six weeks.

At Kingston, Ont., work has been commenced on the new garbage incinerator. The capacity of the plant will be about fifteen tons a day, and it is estimated that the garbage production of Kingston at the present time is only ten or twelve tons a day.

H. H. Pitts, G. M. Pitts, C. M. Pitts, S. M. Pitts, and M. F. MacLeod have incorporated the Pitts Construction Company at Ottawa, Ont., to carry on the business of an engineering construction company and contractors. The capital stock of the company is $50,000.

Press reports state that the order cancelling the contract of the Norton Griffiths Company for harbour improvements at Courtenay Bay, N. B., has been rescinded. The contract amounts to $7,000,000, and its cancellation was due to the slow progress of the work.

The contract received by the Canadian Locomotive Company, Kingston, from the Russian Government for the manufacture of fifty large locomotives will necessitate increasing the number of employees to 1,000. At present there are 450 men engaged in the manufacture of shells.

The Swedish Crucible Steel Company of Canada, Limited, are putting up a large frame addition to their factory at Walkerville, Ont. They are erecting a cupola that will increase their capacity of gray iron to 120 tons. A number of new machines have been added to the plant.

Work will be commenced shortly on the construction of an electric pumping station in connection with the new water supply for the city of Sydney, N. S. It is understood that the tenders have been received, and that the Board of Works will let the contracts at its next meeting.

The Face Brick and Machinery Company, Limited, has been incorporated at Toronto, with a capital stock of $100,000. The Provisional Directors of the company are P. E. McMillen, W. G. Sunter, L. R. Whiting, E. H. Leighton, and A. J. Langley. The firm will manufacture brick and brick machinery.

Pile driving for the salmon cannery now being erected by the Liverpool Canning Company at Herring's Point, B.C., has been completed by the Fraser River Pile Driving Company, and work on the building will be started as soon as materials, including timbers and lumber from the old Schaake machine shops, are taken across the river.

At Montreal, Que., Hepburn Brothers, Limited, is the name of a firm incorporated recently by W. W. Skinner, W. G. Pugsley, G. G. Hyde, C. M. Palliser, and G. D. Hodge. The company, which has a capital stock of $100,000, has been incorporated to manufacture and deal in all kinds of plant, machinery, and builders' and contractors' supplies.

At Whitby, Ont., the Whitby Brick and Clay Products Company, Limited, has been incorporated for the purpose of manufacturing brick, terra-cotta, drain and sewer pipe, and other clay products. The Provisional Directors are J. F. MacGregor, T. S. H. Giles, W. C. H. Swinburne, W. W Fair, and W. B. Sturrup. The capital stock of the company is $250,000.

A new record was created during the month of May in the laying of granite for the new breakwater at Victoria, B. C. According to statistics issued by Mr. J. S. MacLachlan, Supervising Engineer for the Dominion Government, a total of 7,253 tons of granite blocks was laid in that month, and 19,022 tons of rubble were dumped on the foundations extending seaward. 1.334 cubic yards of concrete were laid in addition.

Delay in the undertaking of water-works construction at Saanich, B. C., has been caused by the necessity of subletting contracts for pipe. McLaren & Company, of Scotland, have been called upon by the Government to use their plant for the manufacture of munitions of war, and in order to fulfil their contract for the municipality of Saanich they have had to arrange with other manufacturers for the production of the pipe.

The great dry dock at Prince Rupert, which is the joint property of the Federal Government and the Grand Trunk Pacific, will be advanced so far that it is expected ship-building will be ready to start by next August. The last pontoon was launched last week, and the upper works are being proceeded with. The dry dock when finished will have cost some $3,000,000, and will be one of the largest, if not actually the largest, in the world.

The Georgia-Harris Viaduct at Vancouver, B. C., has been completed, and although the formal opening may not take place until Dominion Day, it is likely that the bridge will be thrown open to traffic as soon as the engineers have certified that everything is in satisfactory condition. The viaduct cost $500,000, and took two years to build. It is constructed of reinforced concrete throughout, and is declared to be absolutely fireproof.

The German and Austrian prisoners now held in the internment camp at Vernon, B. C., will be put to work on the construction of the Edgewood Road between the Monashee Mine and Edgewood, on the Arrow Lakes. The Dominion Government are defraying the cost of the prisoners' confinement and food, and the Provincial Government will pay those who work twenty-five cents a day. The construction of this road will link up the Arrow Lake country by direct route with the Okanagan Lake and valley.

The contract for a large school on Bloomfield, Fairmount and De l'Epee Streets, Outremont, Que., has been let by the Outremont School Commissioners to Mr. L. Beaudry. The site is 270 x 70 feet, and the building will be of four storeys, with the exterior of brick and terra-cotta. The main facade will cover a frontage of 258 feet on Bloomfield Avenue. The building will contain twelve class-rooms, a study hall, an assembly hall, a reading room, and a museum. The teachers' rooms in the centre of the building can be converted into class-rooms. Bowling alleys, gymnasium, and a swimming tank will be provided.

The laying of concrete will be commenced immediately on the new Toronto-Hamilton road between Clarkson and

Oakville. Grading has been completed on that section. At present there are five construction camps along the highway, employing five hundred men, who are now engaged in grading work. It is expected that the number will be increased to seven hundred when concrete work is started. It is proposed to make the route more direct by crossing an arm of Burlington Bay, either by means of a fill or by a high-level bridge. The idea of a fill at this point has been received with considerable favour, on account of its low cost as compared to that of a bridge.

Following the decision of the court in the injunction proceedings in connection with the awarding of a contract for asphalt, the question of calling new tenders for the supply of asphalt came before the Montreal Board of Control. It was sugested by Controller Hebert that fresh tenders be invited for the supply of asphalt required for this year and also for the supply of asphalt for nine or less years, a condition being that an asphalt refinery be established in the city. The City Attorney, however, advised that trouble might result if a contract were given to a firm other than the Aztec Company. It was therefore decided to postpone the whole question, which is complicated by the fact that the city has ordered 1,500 tons of asphalt from the Aztec Company, and that it may have to take delivery unless the company waives its rights.

The Board of Public Works of Vancouver has approved the City Engineer's recommendation for the construction of sewers in Ward Eight to cost $30,700 and in Ward Five to cost $8,150, but the recommendation was ordered referred to the finance committee for sanction and for provision of the necessary means with which to carry on the work. The proposed work in Ward Eight provides for a sewer on Twentieth Avenue and Sophia Street to St. Catherines Street to cost $15,000, and one on Nineteenth Avenue from Sophia Street to Burns Street at a cost of $14,500. Other sewer work in the ward is estimated to cost $1,200. These sewers are intended to connect with the new sewer completed by the joint sewerage board. In Ward Five it is proposed to lay sewers on Victoria Drive from Thirteenth Avenue to Sixteenth Avenue; on Fourteenth Avenue, from Commercial Avenue to Victoria, and on Fifteenth Avenue, from Commercial Avenue to Victoria Drive, costing respectively $2,400, $2,750, and $3,000. These are to follow up the Carolina Street branch trunk sewer.

The work on the new locks on the St. Charles River, Que., is going on apace, and the contractors, Messrs. Quinlan & Robertson, expect to complete the dam this season, thus permitting the new rail and highway bridges to be started next year. The erection of these locks is one of the largest and most difficult public works ever attempted in Quebec, chiefly on account of the conditions under which the operations have to be carried on. Two parallel locks are to be erected, 450 ft. long and 65 ft. wide, which when completed will permit of sailing vessels with a draught of 20 feet proceeding to the upper basin. The locks and dam will be constructed of solid concrete. About two hundred men are employed, and the plant in operation includes a four-yard dipper dredge, fourteen scows, a 50-h.p. gasoline touring launch, and two travelling scows. There are seventeen hoisting engines and a 30-ton crane employed on the construction work in addition to the concrete machinery. It is estimated that the cost of the locks and dam will be $750,000, and the work is expected to take two years to complete.

Contracts awarded recently to the Turbine Equipment Company, Limited, include one from the city of Brockville for one De Laval 2,500,000-gallon gasoline motor-driven pump and another from the town of Orillia for two De Laval 175-h.p. multi-stage motor-driven centrifugal pumps with a capacity of 1,200 Imperial gallons a minute each. These pumps will work against a total head of 315 feet, and will be directly connected to Canadian Crocker-Wheeler variable speed motors.

An electric water-level indicating apparatus has been used for the purpose of indicating the tide level to dredging vessels off shore. The apparatus is fixed on a timber dolphin about half a mile from shore, and consists of a 25-volt Walker Horrocks automatic electric lighting plant driven by a gasoline engine, with accumulators to supply the current to five differently coloured lamps. A float in a standpipe under the timber dolphin operates a number of switches, and every six inches of difference in the level of the water causes the switches to light up different combinations of lamps in accordance with a pre-arranged code. These various groupings of coloured lights indicate levels from zero to 19 ft. 6 ins. The plant is entirely automatic in action, and a time-switch is employed to switch off the lights in the daytime. Messrs. Gent & Company, Limited, of Leicester, England, recently completed this interesting application of their water-level indicating apparatus in connection with dredging work being carried out by an English firm.

The firm of M. Beatty & Sons, Welland, Ont., were successful recently in obtaining an order from the War Purchasing Commission for five carloads of material handling machinery, including hoisting engines, derrick irons, turntables, centrifugal pumps, and clamshell buckets. These machines will be used by the Overseas Construction Corps in Europe. As an evidence of the firm's ability to make prompt shipments of this class of machinery, we are informed that while the order was received on May 29th the machinery was forwarded, knocked down and packed for ocean shipment on June 1st.

Trade Inquiries

The Weekly Report of the Department of Trade and Commerce contains the following inquiries relating to Canadian trade. The names and addresses of the firms making these inquiries can be obtained by those specially interested in the respective commodities upon application to the Inquiries Branch, Department of Trade and Commerce, Ottawa:

732. **Wrought iron and steel.**—A Middlesbrough correspondent has a demand for wrought iron and steel tubes and fittings, and would like to get into touch with Canadian manufacturers able to supply this material.

733. **Steel sheets.**—A Birmingham firm dealing in military equipment is interested in the supply of steel sheets, nickeled, coppered and brassed, and would like to get into touch with Canadian manufacturers. Samples may be seen at the Department of Trade and Commerce.

743. **Iron and steel goods, etc.**—A firm in South America, large importers of iron and steel goods, desire to hear from Canadian exporters of the following: Iron and steel bars, iron girders, builders' hardware, brass tubing, locks, hammer handles, grindstones, metal screws, files, aluminium, and piano wire.

751. **Wire and wire nails.**—A firm in Birmingham is open to consider samples and quotations f.o.b. Canadian port on wire nails, barbed wire and wire fencing.

752. **Wire nails.**—A Birmingham firm inquires for prices of oval wire nails, brad heads, in 10-ton lot sizes ranging from 1½ inches to 6 inches; also wire slate nails 1½-inch x 10g. and wire lath nails 1-inch x 14g. Samples should be sent, and quotations must be c.i.f. Birmingham.

753. **Steel ingots.**—A firm in Birmingham is open to receive quotations.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Assiniboia, Man.
Plans have been drawn for about 10 miles of plank sidewalk to be constructed for the Township Council. Clerk, Frank Ness, Kirkfield Park.

Brockville, Ont.
A by-law has been passed providing for the laying of tarvia pavement on St. Andrew Street. Clerk, G. K. Dewey.

Plans for a tarvia roadway, curbing, etc., on Court House Avenue, have been submitted to the Town Council. Approximate cost, $5,500. Engineer, G. H. Bryson.

Cobourg, Ont.
The Town Council are considering the laying of concrete or asphalt pavement on King Street. Clerk, B. Ewing.

Eastview, Ont.
Tenders have not yet been called for the proposed sewer on Montreal Road. Report published in our issue of June 16th in error.

The Town Council have received tenders on the construction of about 20,000 square feet of concrete sidewalk, and 2,186 feet of sandstone block. Clerk, H. Washington, Cummings Bridge.

Edmonton, Alta.
Tenders on the construction of a watermain to the site of the stock yards will be called shortly. City Clerk, C. E. F. Cox.

London, Ont.
The Board of Control contemplate the construction of a pavement on Park Avenue. Material not yet selected. Engineer, H. A. Brazier.

Lunenburg County, N.S.
Tenders on the construction of 105 culverts will be received until noon, June 26th, by Hon. H. E. Armstrong, Department of Public Works, Halifax, N.S. Plans and specifications at offices of Road Commissioners, Halifax, Frank Boylan, New Ross, Grover Cole, Druggist, Chester, W. Duff Clerk, Lunenburg, and T. B. Simonson, Bridgewater.

Montreal, Que.
The City Council will receive proposals with regard to the garbage disposal plant until July 15th. Secretary, L. N. Senecal.

Orillia, Ont.
The construction of a pavement on Front Street is being considered by the Town Council. Clerk, C. E. Grant. Estimated cost, $7,500.

Pembroke, Ont.
The Town Council are considering the construction of pavements on Hincks, Berlin, and Murray Streets, at an estimated cost of $8,000. Clerk, A. J. Fortier.

Peterboro, Ont.
The City Council have approved the construction of sewers on Westcott, Lansdowne and Maude Streets, and on Lafayette Avenue. Engineer, R. H. Parsons.

Portsmouth, Ont.
The Town Council have received tenders on the construction of sidewalks on Union Street. Clerk, J. W. Henstridge.

Sandwich, Ont.
Tenders on the construction of a large quantity of concrete paving and curbs have been received by the Town Council. Approximate cost, $31,000. Clerk, E. R. North.

Simcoe, Ont.
The Town Council have received tenders on the construction of macadam roadway and concrete sidewalks and curbs. Clerk, W. C. McCaul.

St. Lambert, Que.
The construction of a trunk sewer and purification plant, estimated to cost about $200,000, is being considered by the Town Council. Engineer, E. Drinkwater, City Hall.

St. Vital, Man.
Plans have been prepared for granolithic and plank sidewalks to be constructed on several streets. Municipal Secretary, J. Desjourdes, Grand Vital.

Strathroy, Ont.
The Town Council contemplate laying watermains on various streets. Clerk, F. W. Atkinson.

Toronto, Ont.
The Commissioner of Works, R. C. Harris, has recommended the purchase of two electrically-driven pumps for the High Level Pumping Station, with a capacity of 7,500,000 gallons each per day.

Tenders on the construction of sewers on Dundas Street from Clendennan Street to Runnymede Road will be received until July 6th by the Board of Control. Commissioner of Works, R. C. Harris, City Hall.

Unionville, Ont.
The Village Council are having plans for a waterworks system prepared by James Loudon & Hertzburg, Engineers, 79 Adelaide Street E., Toronto.

Vancouver, B.C.
The construction of sewers estimated to cost $30,700 is being considered by the City Council. Clerk, W. McQueen.

Verdun, Que.
The City Council are considering the laying of asphalt paving, estimated to cost $63,700, street grading at a cost of $28,000, the construction of curbs and gutters at a cost of $41,000, and the laying of cast iron sewer pipe, to cost $2,800. Clerk, G. A. Ward, City Hall.

Walkerville, Ont.
The Town Clerk, C. H. Robinson, will receive tenders until June 24th for the construction of concrete and asphalt block pavement and cement sidewalks on various streets. Plans and specifications at office of the Town Engineer, Owen McKay. Approximate cost, $9,600.

Wentworth County, Ont.
The County Council are about to start work on Caledonia, Stoney Creek, and Green's roads and the Ninth Concession. Approximate cost, $16,000. Clerk, J. W. Jardine, Court House, Hamilton.

Windsor, Ont.
Tenders will be received until June 30th by W. A. Hanrahan, Secretary to the City Council, for the supply of about 1,000 tons of cast iron pipe and valves, and 160 h.p. boiler equipment.

Winnipeg, Man.
Pavements will be laid on Maple and Osborne Streets by day labor, under supervision of City Engineer, W. P. Brereton. Estimated cost, $30,719.

Woodstock, Ont.
The Town Council have engaged F. A. Barbour, Engineer, Boston, to report on a new water supply. Clerk, J. Morrison.

CONTRACTS AWARDED

Bridgetown, N.S.
A contract for the construction of sewers for the Town Council has been awarded to Beeler & Peters, Victoria Street, at $4,750.

Listowel, Ont.
The Town Council have awarded a contract for the construction of concrete paving and catch basins to the Municipal Concrete Construction Company, Berlin, at $1.46 and $1.54 per square yard.

London, Ont.
The City Council have awarded a contract for the construction of 18,000 square yards of asphalt pavement on concrete base to Standard Paving Company, Limited, Central Chambers, Ottawa, at $2.28 and $2.33 per yard.

In connection with the installation of turbine pumps at Springbank, the City Council propose to let the contract for motors to Canadian Westinghouse Company, Limited, Hamilton, at $6,400, the contract for waterwheels to Hamilton & Company, Limited, 479 Reid Street, Peterboro, at $7,595, and for pumps to McDougal & Company, 512 William Street, Montreal, at $4,710.

Morris Township, Ont.
A contract for the construction of culverts has been let by the Township Council to W. Ferguson, Belgrave, at $3.70 per cubic yard for abutments, and $2.60 for superstructure.

Ojibway, Ont.
The Town Council has let the contract for concrete pavement to John Dewhurst, Woodslee. Approximate cost, $100,000.

Orillia, Ont.
The following contracts have been let by the Water, Power & Light Commission:—175 h.p. slip-ring motors to Canadian Crocker Wheeler Company, George Street, St. Catharines, at $3,100; pump, piping and meters, Turbine Equipment Company, C. P. R. Building, Toronto,

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Business Opportunities

AN optimistic note has been struck by a report issued recently by the Canadian Northern Railway. In an effort to discover the actual status of trade in Canada, the company sought the opinions of more than two thousand representative men in all classes of enterprise throughout the country. On the whole, the reports indicate that the period of greatest depression has actually passed: less than ten per cent. of those who have contributed their views to this survey of trade conditions confess to a gloomy outlook. With regard to the probable state of trade after the restoration of peace, the general idea seems to be that conditions will return rapidly to the normal.

Taking the Dominion as a whole, business is shown to be from fifteen to twenty per cent. below the average of last year. Trade in the Maritime Provinces is affected less; while in the West it is far below normal. In Quebec and Ontario business is slow, but shows signs of improvement. The agricultural districts appear to be holding their own: collections in such centres are as good as usual, and activities have not been curtailed to any extent. The chief falling off of trade has been in the large industrial centres.

There is evidence of a disposition to rely upon the crops of 1915, and to qualify expressions of optimism with the remark that the crops will be the determining factor. From late reports dealing directly with crop conditions it seems pretty certain that if the determination of the state of Canada's trade remains with the grain crops there is little cause for anxiety. With the incentive of prevailing high prices the farmers have devoted more time and care to cutlivation; they have used better seed, and have increased their acreage of wheat, and Canada's grain crop for 1915 will show the usual annual increase.

The collapse of the building trades has been the cause of a substantial reduction in the volume of sales of Canadian lumber; but the export trade in lumber has stood up well, and the chief difficulty seems to be in connection with the availability of ships to carry lumber cargoes.

Contracts for military supplies are keeping a large number of machine shops working which otherwise would be practically idle, but the effects are not felt fully yet. The output of shells is but ten thousand a day. The orders for these have been distributed throughout the Dominion, and their influence should be spread pretty evenly.

The leather goods industries are in an abnormally flourishing state. There is a great demand for leather manufactures for the armies of the Allies. Prices have advanced considerably in all lines, the increase being due to the scarcity of raw materials caused by the demands of the military upon the available supplies. A large section of the textile industry is also affected by the military orders, but where these orders are not in evidence trade is somewhat less in volume than it was a year ago. Supplies of raw material from Great Britain have become difficult to secure, even at advanced prices, and it is expected that a scarcity will prevail for the remainder of the year.

The publication of this report has done much to give a better understanding of the effect of the war on Canadian trade. Many people's outlook on the state of trade generally is restricted by the extent to which their own particular line of business has suffered. This is natural, perhaps; but just now the man who has been hard hit by the war, if he be wise, will take a broader view of the situation and recognize the advantages to be gained by turning his energies to other lines of business created by the same war. Many factories now running day and night would be at a standstill if their owners had waited supinely until things picked up in their own line. Instead, by adapting themselves to the changed conditions, they are reaping a rich harvest. Canada has often been called the land of opportunity, and this definition is still appropriate.

Considering the widely-distributed sources of the information contained in this report, it is evident that, while trade is below the normal, it has begun to improve. Taking into account the remarks of many of those who contributed to the report regarding the dependence of trade generally on the 1915 wheat crop, and the reports bearing directly on this crop, it can be seen that there is every reason to expect a decided revival by next year; and if by good fortune the European war should end this year Canada's trade will receive such an impetus as will ensure her a prosperity exceeding even that of her previous banner years.

Our Trade with South Africa

MR. W. J. Egan, the Canadian Trade Commissioner for South Africa, has written an excellent report on South African trade for 1914, having special reference to Canadian imports into South Africa and to opportunities for increasing business between the two countries. South Africa naturally has felt the effects of the European war, and of the disturbances resulting from the incursion of German troops from Damaraland. It is satisfactory to note, however, that Canada heads the list of the three countries which increased their imports into South Africa in 1914, our gain having been $500,000 on a total of $4,840,405. But the Dominion's trade with South Africa is still relatively small, and Mr. Egan points out various directions in which we might increase it. During the last year twenty Canadian firms have established their agents in South Africa, and according to reports good results have been secured on several lines, and all speak hopefully of the future.

Another encouraging sign for future Canadian trade is in the prospect of establishing Canadian commission houses to deal with our exports to this market. Properly organized, such houses would be of great value in increasing our export trade. Many indents for Canadian goods, for one reason or another, are not secured in Canada. There are possibilities also in the establishment of a branch agency or clearing house of some kind in England to look after and quote on many indents which are despatched to the British houses for execution. This is now, and will be for some time, a special feature of South African orders.

With regard to constructional materials Canada makes a poor showing. A glance at the tables in the report shows that the Dominion lags behind in articles by which it should be fairly well represented, especially as we have the benefit of a preferential tariff. The shutting off of European supplies opens the door to Canadian producers, who, we are glad to say, are making greater efforts to introduce their goods into South Africa. We have the advantage of a direct line of steamships, although at the present time these are unable to accept all the cargo offering. The principal obstacle to Canada's permanent increase in trade is the lack of return cargo, as South Africa is primarily an importing country, and exports little of any value to Canada. At the same time there is no reason why we should not do more than we have done—notably in the way of railway material (we are now sending a large quantity of rails), iron and steel, electrical machinery, pumps, engines, paints, varnishes, pipes and fittings. Mr. Egan lays great stress on Canadian firms being represented in South Africa as the only means of securing trade, and states that Johannesburg is the proper location for an agency, particularly for iron and steel and machinery. As an example of what can be done in this way, the imports of calcium carbide are quoted. Representation in South Africa has been the means of steadily building up this export from Canada, and it has been useful in securing extra trade under present conditions.

Although the general imports of lumber decreased, except in the case of oak and poplar, the imports from Canada increased. This is a most opportune time for Canada to increase her exports of poplar, cedar, and pine in the rough, and also of flooring and ceiling. The South African Railways Department are considering the possibilities of securing supplies of ties from British Columbia, while one fairly large order has already been placed in Canada for aspen logs for match making. In manufactured wood the imports from Canada have improved in handles, but the supply should be much larger. Sweden has controlled the trade in box shooks for a number of years, but conditions now are favorable for Canada to secure a larger share of these imports.

Colloids in Road Construction

IN a paper in the May number of the Technology Monthly, Clifford Richardson discusses the relation of colloids to and their effect upon the construction of bituminous roads and asphalt pavements and even water-bound macadam. A colloid is a state of matter, and any kind of matter can be brought into this state. He defines this state as one characterized by a very high degree of dispersion. If a solid, the main characteristic is a subdivision into particles not more than .0001 mm. in diameter and in some cases even .000,006 mm. As the surface area of even the largest of these is 100,000 times as great as that of a cube one cm. on a side which contains the same amount of matter, there is thereby developed great surface energy and capacity for selective absorption.

In studying native bitumens, including petroleum, it is found that some of these form colloidal solutions while others (paraffine scale, for example) do not; he has found, for instance, that Trinidad asphalt contains a considerable amount of clay in the disperse solid colloid form. This offers a method of differentiating the native bitumens or petroleums into two classes, and different oils can be characterized and differentiated by the relative amount of colloidal and diffusable matter which they contain. This characteristic can, Mr. Richardson believes, be developed into a means of differentiating the various bitumens which are used in pavement construction.

The presence of disperse solid colloid particles, with their great surface energy, adds greatly to the cementing or binding characteristic of a bitumen, he states; and he attributes the hard crust of a water-bound macadam to the formation of colloids by the action of water on the fine material, and the cementing of a sand-clay road to the colloids present in the clay.

Tail-Tunnel Regulation in Hydro-Electric Work

By R. D. Johnson*

By applying the principles of the differential surge tank to the regulation of the flow of water in long tail-tunnels running under pressure possibilities which have hitherto seemed unattractive in the design of hydro-electric plans are opened up. The type of construction in which the tail-tunnel flows partly full, reproducing conditions in an old-fashioned tailrace, is necessarily wasteful, and for this reason the writer devised a remedy two or three years ago, but has neglected to publish the fact until now.

The present orthodox type of water power development is arranged to lead the water in artificial channels, pipes or tunnels, at high level, or under high pressure, from one point of a river to another of lower elevation, terminating in a water-driven unit at the power station. In most cases this plan of procedure, making the waterwheel the last link in the chain, is probably the best to adopt, but in some cases there are advantages in an opposite course, which it is the writer's present purpose to indicate.

The idea of dropping the water first through penstocks directly to the water turbine, thence leading it away through a long tail-tunnel, is not new, as there are several plants of this type in the country—notably that of the Niagara Falls Power Company, at Niagara Falls—but in such plants the tail-tunnel is not an integral part of the water system in the sense of an unbroken column from head-water to tail-water, as is the case with the reverse course as commonly adopted. Here there is a definite break in the continuity of flow at the end of a short draft-tube, where the water leaves it and takes up its new course under atmospheric pressure in a partly filled tunnel. In other words, such a tail-tunnel is really little different from an old-fashioned open tail-race. This type of construction is necessarily wasteful.

The reason that it is ordinarily out of the question to permit the tail-tunnel to run full is that such a course would virtually increase the length of the draft-tube to equal that of the tunnel, perhaps a mile or two, and all water-power men are aware of the difficulties arising from an extension of the draft-tube even a moderate distance beyond the unavoidable length.

When the tail-tunnel runs as an unbroken extension of the draft-tube the inertia of the whole water column reacts directly upon the turbine and precludes the smallest sudden change in the gate opening, or at least causes it to be attended by excessive pressure changes, which not only prevent an approach to proper speed regulation, as the load varies, but which endanger the safety of the plant. The recoil of such a column of water following the sudden shutting off of the water at the wheel would be very likely to shut down the plant for extensive repairs.

That it becomes feasible to operate successfully these long draft-tunnels by the use of a small differential regulator connected to the tunnel at the end of the draft-tube proper is easily demonstrable, and needs only to be stated to one who has taken the trouble to familiarize himself with the "differential principle" as described in the October, 1914, "Proceedings" of the American Society of Civil Engineers.

It is not necessary to go into the theory of this recent application of this device, because its function is almost identical with that of the differential surge tank, as applied to the regulation of a long pressure, up-stream from the waterwheel. There is, however, one important difference—the latter must be amply proportioned to take care of the energized water in the system following a complete shut-down of the plant, while running at maximum load, whereas the tail-tunnel regulator needs no provision for such a contingency, because a complete rejection of the water by the wheel gates merely permits the energized column to go on discharging as before, and possibly to draw in some air through the regulator if its supply of water has been previously exhausted. Thus it becomes apparent that a minimum size of tank is sufficient, having capacity for normal regulation requirements, and this usually necessitates a small enough diameter, especially for very long tail-tunnels, so that the extra rock excavation involved in connection with the wheel pit itself is not a particularly important item.

A moment's consideration will impress upon the mind the economical necessity of having continuity of flow wherever long tail-tunnels themselves are required, for if the tunnel is limited to run partly full, not only must its cross-section and grade be ample to prevent filling, but its mouth must be placed at the extreme high-water mark of the river. The high-water stage may seldom occur, and therefore the head represented by the fluctuation of the river level is almost continuously wasted. In some rivers this would amount to a large sacrifice of energy, not infrequently a substantial proportion of the total head. On the other hand, the submerged tail-tunnel may be designed for the maximum economical velocity, however high that may work out to be, just as in the case of a pressure-pipe, giving it the minimum economical cross-section. It may also have its mouth below the lowest water mark, thus utilizing the total available head.

The class of topography which best lends itself to this type of development is where, in a rocky formation, the surface drops off gradually from the intake to the mouth of the tailrace, so that the orthodox development, not finding any high ground above the power house site, would be constrained to carry the water a long distance under a high average pressure. If the head were high, it might well be out of the question to construct a surge tank unless to operate under compressed air, which, although perfectly feasible, and proper when unavoidable, is usually somewhat expensive.

In such a natural location the advantage of the long sealed tail-tunnel is so obvious that it is scarcely worth while to dwell upon it; but it may be well to call attention to the fact that not only is it frequently cheaper, but in some cases the other course would not be commercially feasible, or, sometimes, even mechanically possible. There are, however, many instances where the choice is not so readily determinable, and it is desired to point out the main items of advantage of the tail-tunnel type, which are the first to strike the mind. A pipe or conduit under pressure and located upstream from the waterwheel is sometimes more costly, and from its very nature is subject to more concern, both as to construction and maintenance, than a tail-tunnel which is running under very slight pressure, where a leak would do little harm and rupture is impossible.

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*Johnson & Wahlman, hydraulic engineers, New York.

The surge tank terminating a long pressure system is always a great anxiety to the engineer, on account of the possibility of ice troubles and its menacing location right above the power station. The tail-tunnel regulator is free from both these causes for concern, and is, furthermore, decidedly smaller, because it does not have to provide for complete shut-downs, as before pointed out.

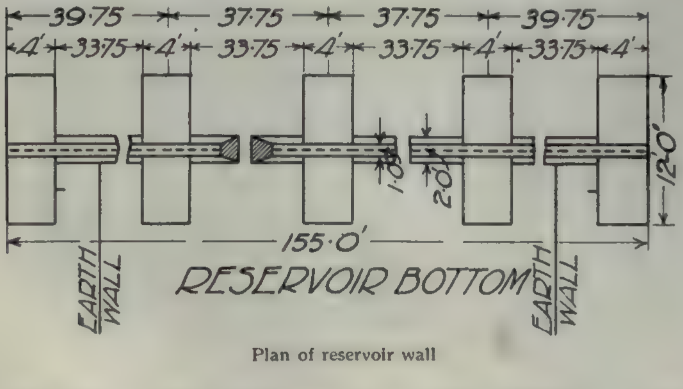
There is no doubt that this type of development has been too long neglected, and the writer believes it will soon have a more prominent place with the engineering profession, because it opens up possibilities which hitherto have not seemed at all attractive under the standard system. That there are many locations where such possibilities exist is a matter of common knowledge to water power men.

The advantage of the "differential principle" in dealing with these problems is, if possible, more marked than in the ordinary case of a pressure pipe, because, not only are all the arguments for it exactly the same, but also there is an added incentive toward economy in size which it favors on account of the rock excavation required to accommodate the regulator.—Engineering Record.

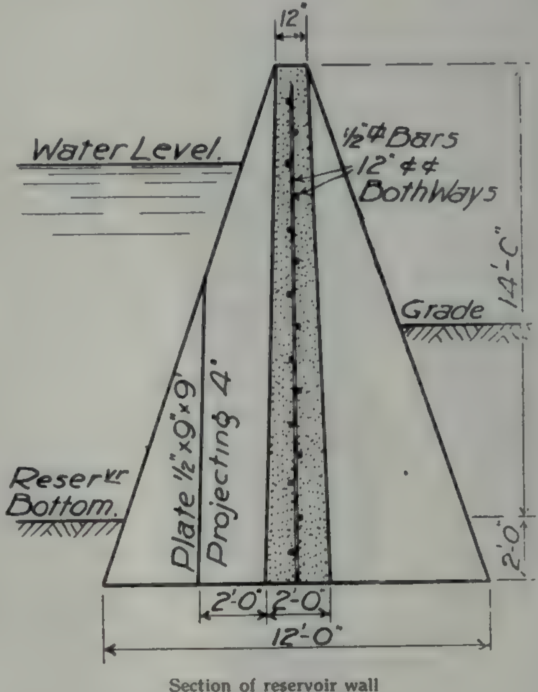
Water Supply for a Small Town

By F. W. Forbes, Little Harbour, N. S.

IN 1912, shortly after its incorporation, the town of Trenton, N. S., faced the problem of a water supply. Different propositions were made by the town of New Glasgow for a supply from their gravity system, but as these stipulated for the amalgamation of the two towns Trenton decided on an independent system. A steep hill within the town limits and overlooking the town proper, which was full of springs, was looked upon as a probable source of supply; so it was decided to tap it, and in the spring of 1912 two bore-holes were put down to a depth of 300 feet. Bedrock was encountered at a depth of 20 feet, and at a depth of 250 feet a stratum of soft rock about two feet in depth was encountered, and at this depth the greatest flow of water was found. The water rose to within 135 feet from the surface, and a cylinder and pump rods were connected up with the walking beam of the drilling machine and a test made of the ten-inch hole. This test was a continuous one of six days' duration, and an average of 208 gallons a minute was obtained. It was at this stage that the writer was called upon to design a system of distribution for the town. Levels were run from the river-bank to the bore-holes at the summit of the hill, which showed an elevation of 284.6 feet. Here it was decided to construct a reservoir, and as the soil overlying the rock was a stiff clay of impervious nature, no better material could be obtained for earthen embankments. These were built with a slope of 1:1 on the inside and 2:1 on the outside. Riprap was placed on the inside slope to protect the embankment from washing down. As the town is a growing one, provision was made for an extension of the reservoir by putting in on one side, instead of an earthen embankment, a concrete wall, the dimensions of which are: length, 155 feet; depth, 18 feet; thickness, 2 feet at the bottom and 1 foot at the top. Five abutments were built in; these were 12 feet across at the base and 4 feet thick, and were carried up to just the thickness of the wall at the top. This wall was reinforced throughout with ½-inch steel rods placed twelve inches apart each way. In this wall is placed a section of 8-inch pipe with a gate valve, and when the growth of the town warrants the expense of an extension another section will be excavated, and the concrete wall between the two will allow of one section at a time being drained off and cleaned.



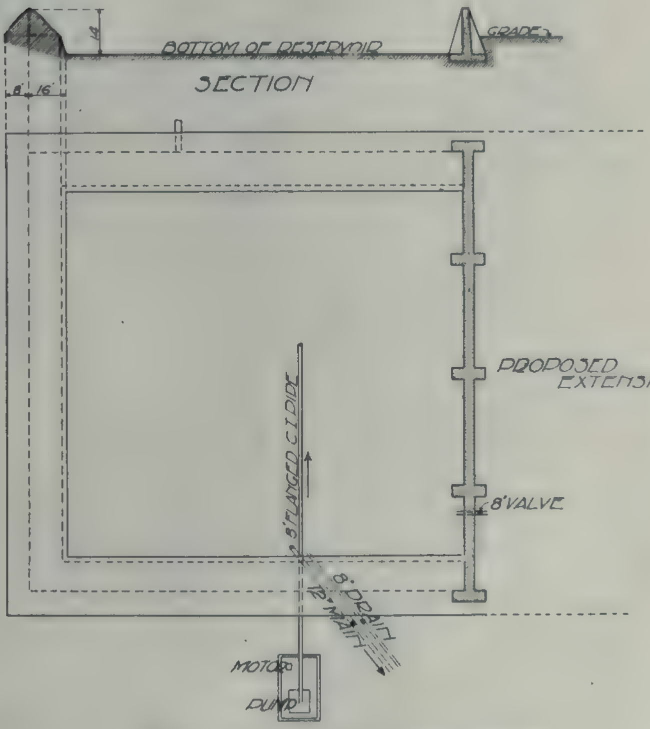
Plan of reservoir wall



Section of reservoir wall

The intake is placed two feet above the bottom of the reservoir, and to this two feet of water a drain has been placed in the bottom which will be connected with the sewerage system of the town and will serve to flush the sewers.

A proper pump was decided on next. The cylinders and rods which were used to test the bore-hole, and which the Town Council had intended to use as a permanent pump, were discarded as being inefficient, and a Deane Triplex pump was purchased. The pump is operated by an electric motor of 20 h.p. There is an automatic starting and stopping device, which is merely a float in a tank connected with the reservoir, and as it rises or falls the switch is thrown out or in. This worked all right, but was found to interfere with operations at the power house of the company supplying power, as at times the pump would start up when the peak load would be on at the power house. Two alarm clocks were then obtained, and so set that at a stated hour the alarm keys of one unwinding would throw in the switch, and the other a few hours later would throw it out. All the attendant has to do is to go up and wind and set the clocks each day.



Details of reservoir, showing proposed extension

I cannot speak too highly of the advantages of the Triplex type of pump, and for the benefit of those who have not seen one perhaps a word of explanation would not be out of place. The cylinder contains three plungers operated by hollow rods working inside of each other and connected to the crank-shaft by cross yokes. The arrangement of the cranks at the crank-shaft is the secret of the success of this type of pump. They are so arranged that just before the first plunger reaches its maximum height the second one begins to take up the load, and so on with the third; so that a constant flow of water is maintained through the discharge pipe, and there is a uniform strain on all parts of the pump-head and rods. I might state in passing that during the contractors' test of one week's duration not a bearing of the machinery became heated, or even warmed.

The pipe-line from the reservoir to the town consists of about 1,500 feet of 12-inch pipe, and branching at right angles each way a 10-inch line is laid. This 10-inch line is across the hill and runs the full length of the town, and from it 6-inch lines will be laid down the various cross streets.

The contract price for the construction of the reservoir was $4,496, which with extras was increased to about $5,000. For trenching, laying and caulking, and backfilling 12-inch pipe-line the cost was 44½ cents a lineal foot, and for the 10-inch line 38½ cents a foot.

I have not the exact figures of the pump and its erection to hand at the present time, but it was in the vicinity of $7,000.

The contractors for all this work were the Doane Engineering Company, of Halifax, who carried it out in a most efficient manner.

Painting Steel to Prevent Electrolysis

REINFORCING steel embedded in concrete which is so located as to be subject to the action of stray electric currents is in danger of being disintegrated by electrolytic action, especially in the presence of moisture. It has been proposed, says Engineering Record, that such steel be given a protective coating of paint as a preventive measure, although the weakness of the bond or adhesion between painted steel and concrete was generally deemed so important an obstacle to this practice as to condemn it entirely. Further, previous tests seem to have shown that common paints are not absolutely impervious to moisture. In an article appearing in that journal more than a year ago E. B. Rosa and B. McCullum discussed the results of tests of over forty common paints, of which not one withstood a potential of 4 volts for any length of time, pitting of the steel occurring within a few months in all cases. They concluded that common paints may even increase the tendency to dangerous electrolytic action because of the concentration of such action in small areas where the paint films break down.

New Tests

New light is now thrown on these questions by an article entitled "Paints to Prevent Electrolysis in Concrete Structures," by Henry A. Gardner, Assistant Director of the Institute of Industrial Research, Washington, D. C. This article, printed in the March issue of the "Journal" of the Franklin Institute, contains a complete discussion of the results of about fifty tests on painted steel rods embedded in 1:2 Portland cement mortar cylinders. Two series of tests were made, differing mainly in the fact that the second series was continued for only 300 hours—240 hours under 30 volts, and 60 hours under 55 volts, with the cylinders always immersed in water up to within 1 in. of the top surface.

The first series of tests was made as follows: At the age of one month the cylinders were all connected up in parallel for 24 hours under 30 volts; then, since the current passing was found to be very small, they were placed in about 2 inches of water for one week. In a few cases it was found that cracks appeared near the bottom where moisture had affected the films of paint. They were then immersed in water up to within 1 inch of the top, and continued under 30 volts for ten days longer.

In all cases the current readings were made daily, and cracking was shown whenever the current was appreciable. The painted rods were given two coats of the paint to be investigated, allowing an interval of one week for drying. Bituminous paints, oil paints, aqueous paints, lacquers, and oils and varnishes were tested. Two specimens contained unpainted rods which showed much earlier cracking and disintegration. It is impossible to give here the results in detail, but in general it was found that bituminous paints, a few oil paints, lacquers and varnishes gave the best results.

Tests of Bonding Strength

In order to determine the effect of paint upon the adhesion between steel and cement mortar a similar set of specimens was tested in a Riehle testing machine. Pressure was applied upon the painted iron rod projecting from the top of the cylinder until the bond was destroyed, and the comparative strength thus determined. Some of the water paints and lacquers showed bonding strength about as high as the plain steel, but failed to act as insulators; while others were good insulators, but low in bonding strength. Most of the oil-pigment paints made with raw linseed oil gave poor or only fair results, while much better results were obtained with boiled linseed oil, which dries to a harder, less porous, and more fully saturated film.

A very effective method for increasing the bond between the painted steel and concrete is to "sand" the painted surface just before it becomes dry. This produces a rough surface, which was found to increase the bonding strength as much as 100 per cent. in one instance, and to give much better insulating values.

Important Results and Electrolytic Action

Wherever there were voids in the surrounding mortar, at or around the painted rods, corrosion was most severe, and pitting was shown. The breaking down of a paint film, probably due to its having been broken through by enclosed hydrogen gas developed by the electrolysis of the water in the damp concrete, was always recorded by a sharp rise in the amount of current passed, and a noticeable fizzing sound. Bubbles of gas which burst with an audible explosion when lighted were brought to the top around the iron electrodes, sometimes carrying soft oily products. Such disintegrating effects of electrolytic hydrogenation might be prevented by thoroughly oxidized coatings, which could be obtained by allowing a period of sixty days for the drying of oil paints before using in the cement.

Paints which form highly impermeable films keep water away from the underlying iron and offer great resistance to the passage of electric currents. Previous investigations made by Mr. Gardner have determined the actual degree of porosity shown by various types of paint films, as reported in Bulletin 18, Scientific Section, Paint Manufacturers' Association of United States. The addition of a pigment to an oil usually increases the resistance to moisture and makes a more impermeable film.

Conclusions

The corrosion of metal embedded in concrete structures, by stray currents of high voltage, is often productive of serious effects. The use of properly-made paints upon such metal constitutes a safeguard that should not be neglected by the engineer. Such paints may be prepared from the following substances.

The vehicle should contain: (1) Boiled or bodied oils or products which dry to a fairly saturated film; (2) oils which dry by semi-polymerization rather than oxidation; (3) oils which dry to a flat rather than a highly glossy surface.

The solid portion should contain a percentage of: (1) Pigments which are coarse and which therefore tend to form films having a rough surface; (2) pigments which are inert and which do not act as conductors of electricity; (3) pigments which are either basic or of the chromate type.

The painted metal should be "sanded," if possible.

An Efficient Recording Gauge for Weir Measurements

By David E. Adams and Earl I. Roberts*

THE city of Columbus is having made a sewerage survey under the direction of Prof. F. H. Eno, of the Ohio State University, and while employed upon this work as inspectors the writers designed and built the gauge described herewith.

Our original intention was to build a gauge for the measurement of the dry-weather sewage flow only and for use with metal weirs, which had been placed in various sewers of the city, but we are now using these gauges also for the measurement of storm flow, and they are giving excellent service.

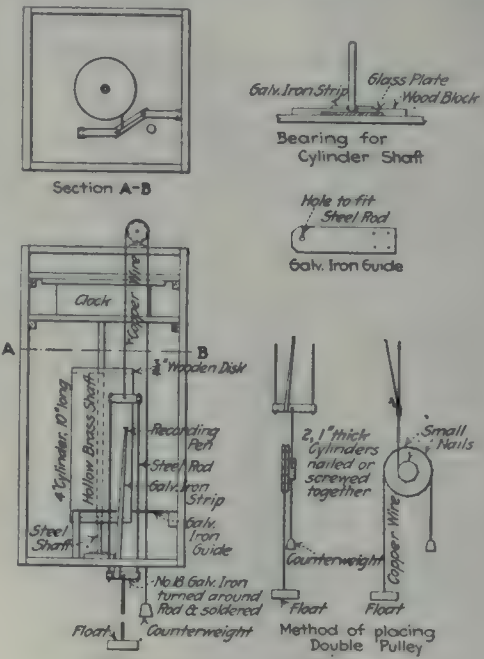


FIG. 1 FIG. 2

Details of recording gauge

The gauge consists of a wooden float covered with galvanized iron, to which is attached a framework of two small steel rods connected by galvanized-iron strips, which carries the recording pen. To the upper end of this framework is attached a cord running over a pulley above and carrying a counterweight. The cylindrical drum carrying the record is covered with thin galvanized iron, and is driven by an eight-day double-spring clock manufactured by Seth Thomas, Thomaston, Conn. The record sheet is fastened on the drum by rubber bands at the top and bottom.

The framework carrying the pen is prevented from moving laterally by means of guide strips, in which holes to fit the steel rods are made, and also by means of the counterweight. The bearing for the drum is made as shown in the drawing by the use of a small glass plate. The shaft carrying the drum is fixed rigidly to the clock, and is geared so as to make one revolution in twelve hours.

The whole apparatus is built in one box, and holes are cut in the top and bottom to allow for the float wire and counterweight cord. In the gauge used by the Massachusetts Department of Health the recording pencil is carried on a rod which in turn is guided in its vertical motion by a small arm moving in a slot. The rod to the float must not be too long, or its weight would prevent the free working of the float; hence, if it were desired to install the gauge in a manhole, say 10 ft. above the level of the sewage, there would probably be come difficulty in its working.

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* Writing in the Engineering News.

As gauges of this type record the actual variation in the flow or head, the cylinder must be of such height as to cover this variation. In order to measure greater variations without the use of a very high cylinder (as during a storm) we have used an auxiliary double-pulley arrangement as shown in Fig. 2. This requires the use of another small counterweight, but it has worked very satisfactorily. By this arrangement the range of the cylinder may be increased according to the ratio of the circumferences of the pulley rings.

The advantages claimed for this gauge are: (1) It is extremely simple and easy to build; (2) by means of adjusting the length of the float wire it may be installed at any height above the flow line; (3) the gauge is covered and thereby protected when placed beneath a perforated manhole cover; (4) its cost is low; (5) it may be installed easily in sewers, sump holes, or open streams.

Modern Garbage Disposal Plant at Berlin, Ont.

A NEW garbage incinerator at Berlin, Ont., was opened officially on May 28th. A number of municipal officials from other cities were present.

The plant illustrates the latest developments in connection with the destruction of garbage. Oil fuel is used to start and generate heat for the destruction of all garbage that will not burn unaided. Two burners are used in the animal chamber, and a separate burner in each of the two garbage chambers. The use of oil greatly facilitates the obtaining of a high degree of heat in a short time. It is understood that the heat of the furnace can be raised to 1,800 deg. Fahr. in thirty minutes. By an interesting arrangement the foul air arising from the garbage on the dumping floor is drawn through a pre-heater by a large fan and used as a force draught to keep up the combustion in the furnace after the oil burners are turned off.

The incinerator is guaranteed to consume fifteen tons of garbage in twenty-four hours. Tests made by the City Engineer show that the plant consumed 31,000 pounds of garbage of all classes in less than eight hours, besides a horse weighing 1,350 pounds.

An important feature of the new plant is the entire absence of odours either inside or outside. When the horse was burned at the opening of the incinerator no smell could be detected from either the charging opening, from the furnace doors or from the exterior smoke stack.

The incinerator is of the single cell furnace type, and one or both cells may be used at a time. The cells are designed so that in case of repairs being necessary to one the other may be kept in full operation while the other is shut down. The animal chamber is placed next to the main combustion chamber and receives the waste heat from the two garbage cells. When an animal is to be destroyed the heat is raised by the use of the oil burners.

All the fire chambers have water-sealed doors which prevent the escape of any of the gases from the combustion of waste and keep cold air from entering the furnaces. The exclusion of draughts of cold air from the furnaces has a material value in preventing sudden contractions which would have a destructive effect on the furnace walls.

Exterior view of plant

The building is entirely fireproof. The dumping floor is constructed of reinforced concrete, while the upper storey is built of steel and corrugated iron. The smoke stack is of brick.

Provision is made for the drying of all wet material amongst the garbage before it is raked over the fire-grate, where all refuse is reduced to ashes and clinker.

A motor-driven suction fan provides air circulation.

Clinkering doors of furnaces and clinker car

Dust pockets and paper screens are provided to prevent any dust or paper blowing up the stack. The second combustion chamber burns all gases arising from the burning in the first chamber.

The incinerator was built by The Ideal Incinerator and Contracting Company, Limited, of Toronto, on their own patented design.

Floating Concrete Caissons in Use

By Harrison S. Taft, assisted by O. D. Jones

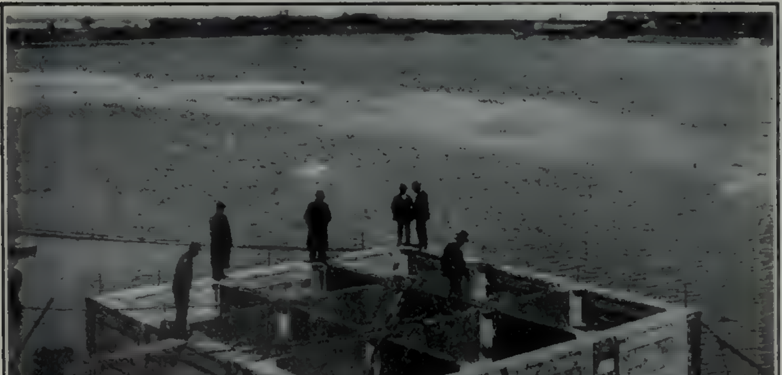
BY the kind co-operation of Professional Memoirs, Corps of Engineers, United States Army, Washington, D.C., who lent us the illustrations, besides giving us permission to reprint part of Mr. Taft's article, which appeared in the March-April issue of that paper, we are enabled this week to present a well illustrated description of the use of floating concrete caissons in several marine undertakings in Canada and the United States.

The introduction of floating concrete caissons into Canada seems to have been the results of the work of Mr. Tromanhauser, who, in 1910, developed a type of caissons having a wooden bottom with concrete side and interior walls. While the use of wood may be permissible in fresh and non-teredo infested waters, it would seem that such a use of timber would not work out favorably to such undertakings in teredo infested waters unless the wooden bases were so well sunk into the soil as to preserve them against attack from the worm.

The first work done in Canada with floating concrete caissons by Mr. Tromanhauser was in the building of the foundation wall of a large building at Goderich, Ontario, in 1910. Four wooden caissons 54 feet long, 14 feet wide and 5 feet deep were first constructed and launched. After launching, the concrete side and cross interior walls were started from the floor of the wooden caisson and built up 2 feet at a time to a height of some 20 feet. The interior partitions divided each caisson into six compartments 9 feet by 14 feet each. To insure good work, the fresh concrete was always kept above the water level until hardened. In order to maintain stability, it was necessary to place rock ballast in the compartments of the caissons as the walls were carried up. After the proper height had been reached, the semi-concrete floating structures were towed to their position in the sea wall and sunk by admitting water through valves in the lower part of the structures. After all the caissons had been sunk to place, they were filled with rock ballast and the decking put in place.

Following up his first successful attempt with floating concrete caissons Mr. Tromanhauser made use of the same principle for the foundation of a grain elevator tower at Goderich in 1912. The caisson was 30 feet square by 24 feet deep and contained nine compartments. The outer walls of the caisson were 12 inches thick, the partition walls 10 inches. The same mode of constructing the crib as in the case cited above was used, and the whole structure sunk on to a prepared rock bottom by filling the interior compartments with sand and gravel. Piles were also inserted in the fill so as to transport directly the weight of the tower to the rock bottom. A concrete slab was placed over the top of the filled caisson and the concrete tower erected thereupon.

Completed Tromanhauser pontoon used at Goderich.



Completed crib being sunk on tower site at Goderich.

Goderich Breakwater.—As the direct result of Colonel Judson's success with floating concrete caissons on Lake Michigan, the Canadian Government decided to adopt his system of construction in the building of a long breakwater at Goderich, on Lake Huron, Ontario. This work was started in the fall of 1911 with the building of three concrete floating caissons, each being 100 feet long, 26 feet high, with a width at their base of 35 feet but only 30 feet at their tops, thus giving a tumble-home of 2½ feet on each face. The caissons were divided into twenty-four compartments by means of two longitudinal and seven cross concrete partitions. These three caissons were sunk in the inner harbor at Goderich during the winter of 1911-1912, being refloated in the spring of 1912 and put in their proper place in the breakwater along with three other caissons that were constructed during the spring of 1912, thus making 600 lineal feet of work completed during one summer.

In the construction of the caissons a form of floating scow dry-dock was adopted by the contractors. This dry-dock consisted of a specially constructed scow, 114 feet long, 44 feet wide, with sides 11 feet high, the bottom of the scow being built with special care as regards its use. One end of the scow was so built as to swing outwards and thus permit the concrete caisson to be floated out when built to a proper depth.

The base of the concrete caissons, properly reinforced, was first poured directly upon the deck of the scow. The interior and exterior walls were next brought up 3 feet at a time simultaneously, care being taken to secure a water-tight joint between each pouring by means of grout. By the time the concrete walls of the caisson had reached a height of 14 feet, the top of the sides of the scow dry-dock were almost submerged. By filling the space between the sides of the concrete caisson and the walls of the scow dry-dock with water and by placing heavy weights therein, the scow dry-dock was parted from the base of the caisson and sunk on to the bottom of the harbor. The end gate was then opened and the caisson towed out, floating on its own bottom. The further upbuilding of its walls was then proceeded with as in case of an ordinary wooden caisson. The weights being removed from the sunken scow dry-dock and its gate closed, the structure floated at such a draft as to bring its sides above the water level, which permitted of its being pumped out and another caisson built therein while the first one was being finished in a floating position. Not only was great care taken in the mixing and placing of the concrete, but regular tests were made of the ingredients so as to secure a water-tight structure.

While the caissons were being built the bottom of the lake where the caissons were to rest was brought to a level by dredging and sweeping, the sweep being a reinforced concrete beam, 12 by 12 inches by 40 feet long. Since the outer face wall of the caissons was thicker than the rear wall it was necessary to place ballast in the caissons in such a location as to secure a more uniform draft than would otherwise have existed.

After being towed to position the caissons were sunk into position upon the prepared bed by pumping in water, an operation that took about five and one-half hours, at which time the caissons became safe against any ordinary storm, their tops being but 2 feet above water level. The various compartments were next filled with stone, sand and gravel. A concrete superstructure was then built up on top of the sunken caissons to a height of about 11 feet above lake level, the concrete extending down some 6 feet into the two outer rows of compartments.

During the season of 1913, another 600 feet was added to the breakwater by the same mode of construction as above described, the caissons being 28 feet deep, instead of 26 feet, on account of a greater depth of water. Another 400 feet was added in the season of 1914. The four caissons which formed this addition had been built in the fall of 1913 and sunk in the harbor during the winter, and were refloated and put into position in the breakwater in the spring. The total length of this piece of work is 1,660 feet, the longest individual piece of work of its special mode of construction built in America so far, thus showing the great faith the Canadian Government has in Colonel Judson's system. A heavy riprap fill of triangle shape exists along the outer face of the breakwater to a depth of 14 feet.

The exterior walls of the caissons are 16 inches thick, the inside face walls 14 inches thick, all built without taper. The base is about 24 inches thick, the entire structure being well reinforced and having substantial fillets at intersections of all walls.

Welland Canal.—In the rebuilding of the Welland Canal a very extensive use of floating concrete caissons is being employed, special new features having been worked out to suit local conditions. This undertaking represents the latest development of Mr. Tromanhauser's system, combined with a system of removable wooden bottoms for the caissons as worked out by Mr. J. L. Weller, engineer in charge of the improvements, so as to permit of their repeated use and to allow of the interior fill resting directly upon the soil and not on the wooden bottoms. The caissons being used are 111 feet long, 38 feet wide and 34 feet deep, having eighteen compartments each, weighing about 2,000 tons. When afloat they have a draft of about 16 feet and a freeboard of 18 feet. In order to keep the centre of gravity as low as possible, the walls are made thicker at the bottom of the caisson than at the tops. Even with this precaution, it is said that the centre of gravity of the complete caisson when afloat is near the water line and that they are very sensitive in stability.

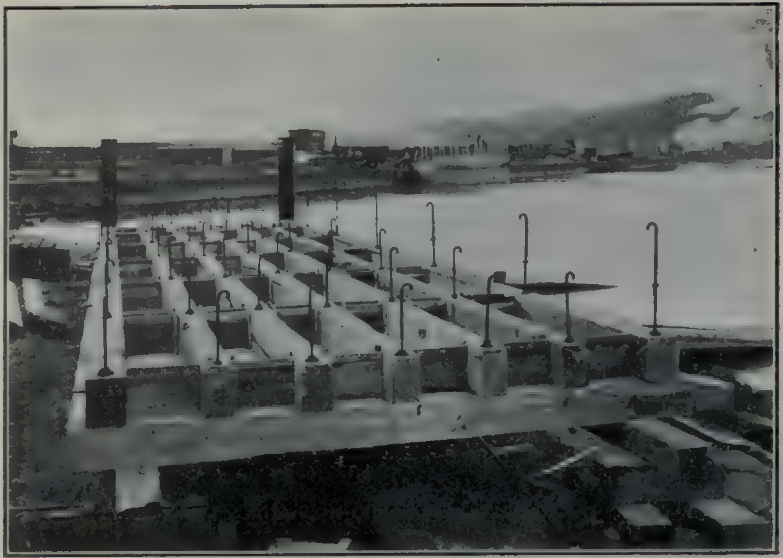
United States

The first application that Colonel Judson seems to have made of his idea of floating concrete caissons was in the construction of Government breakwaters on Lake Michigan in 1908, these undertakings apparently being the first application of floating concrete caissons in the United States, if not in America.

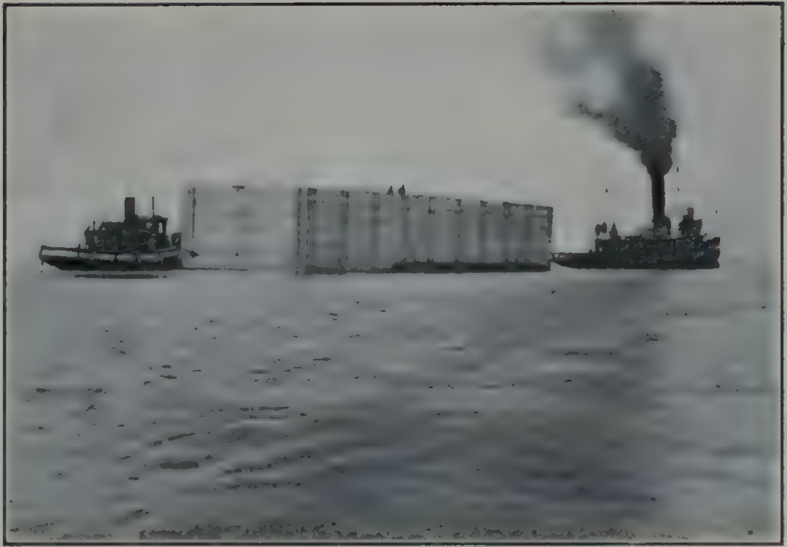
To determine the effects of frost upon the interior fill of a reinforced concrete caisson, a small structure (7 by 6 by 5½ feet, approximately) with walls from 4 inches to 5 inches thick, was constructed by Colonel Judson in 1907, filled with sand and covered over with a concrete slab and allowed to remain in an exposed position all winter. The results of this experiment were such as to justify the use of concrete caissons on a larger scale in the Algoma, Manitowoc and Milwaukee breakwaters, as no damage was done to the experimental caisson on account of frost action.

Algoma.—The twenty caissons used in building the Algoma breakwater were 24 feet long, 15 feet wide, 12 feet 4 inches high, of a rectangular shape, the caisson part of the breakwater being 511 feet long. As the caissons have to withstand a severe wave action due to the 140-mile fetch of the seas, a heavy construction was used, the exterior walls being 12 inches thick, the athwart middle partition 10 inches thick, while the bottoms are 16 inches thick. The middle partition wall divides the caissons into two compartments of about 10½ by 13 feet, a 1:2:4 mixture being used throughout. Each caisson weighed 119 tons, corresponding to a draft of 9.7 feet, giving a freeboard of 2.6 feet when afloat. After launching, the caissons were towed 12 miles through the open water at a speed of 2 miles per hour to their final location, the place of manufacture having been at Kewaunee, 12 miles south of Algoma. After being sunk by water ballast, the interiors of the caissons were filled with broken stone to within 4 feet of their tops and the rest with a lean concrete. A concrete superstructure was erected over the top of the caissons. The caissons rest upon a pile foundation filled in with riprap.

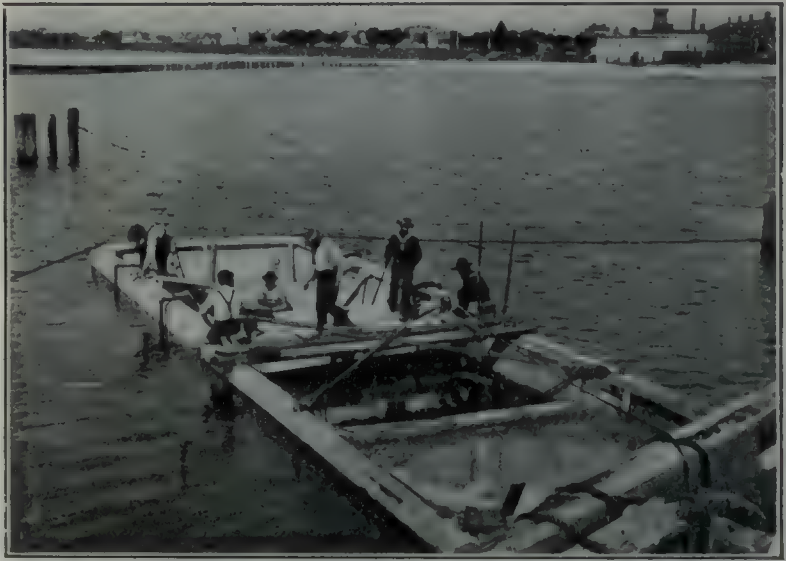
Manitowoc.—The building of the Manitowoc breakwater followed immediately after the Algoma,



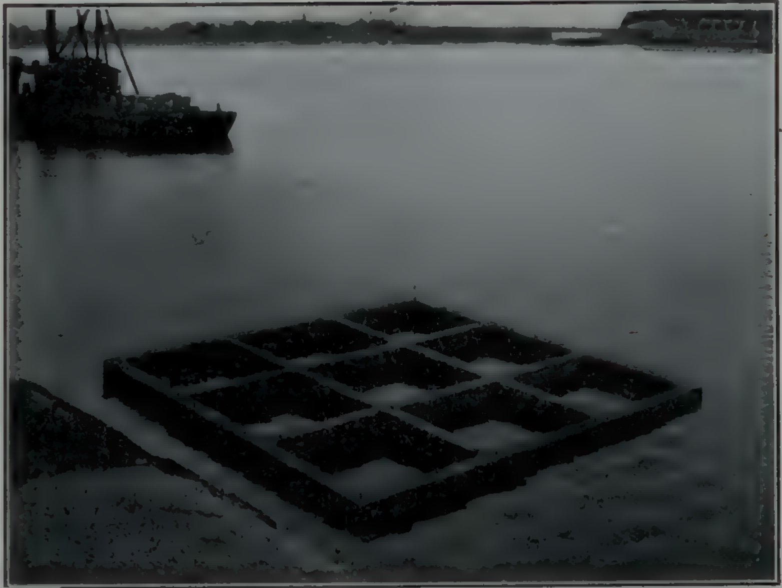
Tromanhauser water-tight pontoon bottom used at Goderich.



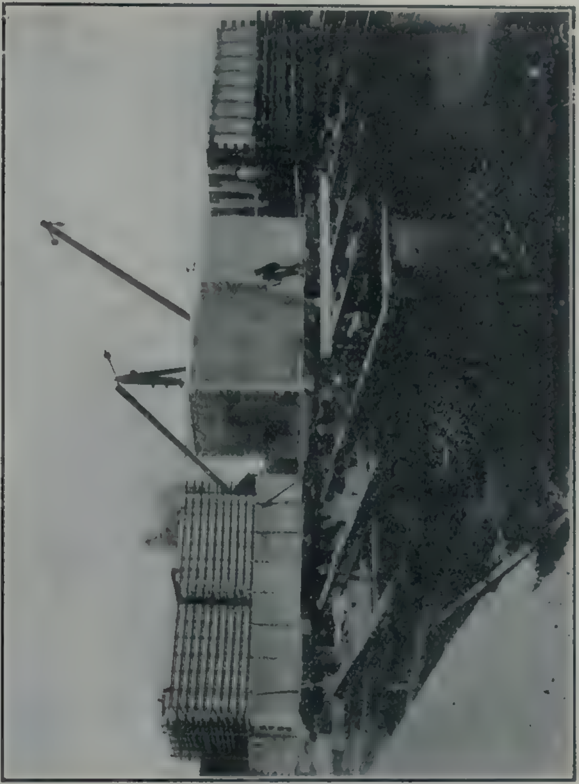
Towing completed caisson to Welland Ship Canal.



Reinforced concrete caissons being filled and sunk with water through siphons at Algoma Harbour.



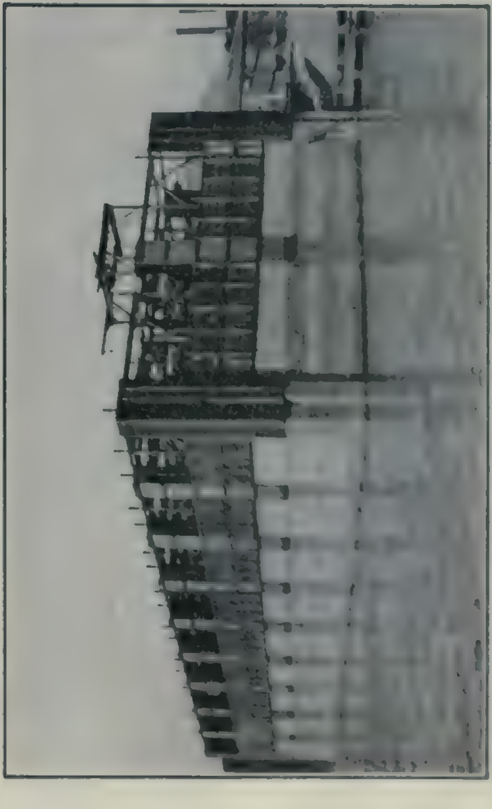
Concrete crib in position on rock bottom in harbour at Goderich.



Reinforced concrete caissons under construction on launching ways.

Reinforced concrete caisson being launched at Algoma Harbour.

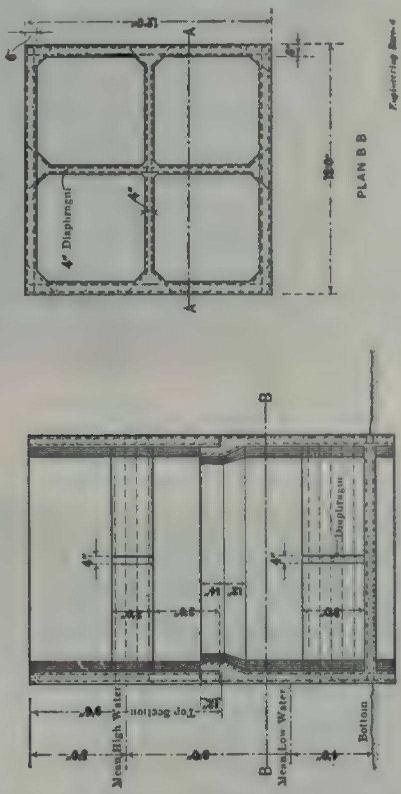
Filling top of breakwater at Algoma Harbour with concrete from mixer.



Concrete crib on the Welland Ship Canal nearing completion.

the same plant, etc., being used to construct the twenty-four concrete caissons needed. Twenty-two of the caissons used at Manitowoc were 24 feet long, 14 feet wide and 11 feet 4 inches high. Their external walls are 10 inches thick, their cross walls 8 inches, the bottom 14 inches. The entire set was launched in the fall and kept afloat all winter, no damage being done to them through stress of weather. The caissons had to be towed 29 miles in the open lake and were sunk into position the next spring following their manufacture. Two additional caissons of a special design were also used in this work, the entire length of the caisson breakwater being 580 feet. The interior of the caissons were filled with rock for the rest of their depth. These caissons rest upon a rubble fill.

Milwaukee.—The next use of concrete caissons by Colonel Judson was at Milwaukee in 1910, the work following the Manitowoc undertaking. In all, fourteen caissons were used at Milwaukee. The outermost four are 54 feet long, 18 feet wide and 15 feet deep. Their exterior walls are 14 inches thick; the two interior partitions 12 inches and their bases 18 inches. The cross walls divided the caissons into three compartments about 16 by 16 feet. Each caisson weighed 352 tons, corresponding to a draft of about 13 feet. The inner caissons were ten in number, each one being 36 feet long, 15 feet wide, 12 feet deep. The walls were 12 inches thick, the interior partitions 10 inches and the base 16 inches. Each caisson had three compartments of about 12 by 13 feet and weighed 175 tons. After being sunk on to a pile foundation they were filled with stone, capped with 4 feet of concrete and now form a pier 576 feet long.



Plan and section of reinforced concrete caisson for Glen Cove pier.

In building the Algoma and Manitowoc caissons, a pile foundation of nine piles properly capped was prepared and covered with 4-inch planks into which were driven 8-inch wire spikes. These spikes projected into the base concrete and thus bound the planks to the caissons, the planks becoming a part of the caisson structure when put afloat. The caissons were built on a level keel and not on an incline, as is the usual practice in ship work. In order to prevent any inflow of the water during launching and towing operations, a water-tight wooden deck was secured to the top of each caisson. After the caissons had been completed their weight was transferred from the pile structure to the launching ways and they were launched overboard.

In a launching operation at Kewaunee three sets of ways were used, each set being 24 feet wide, 103 feet long with a draft of 6 feet at the out-shore end, giving a drop of 3.7 feet. The launching weight of the Algoma caissons was taken as 2.65 tons per square foot. The piles under the launching ways were figured for 15 tons each.

Glen Cove.—The next use of floating concrete caissons in marine work in the United States appears to have been at Glen Cove, Long Island Sound, in the construction of a small wharf for pleasure purposes in the winter of 1909 and 1910; floating caissons were made use of for the piers that support the overhead bridge or runway. Some of the piers were 12 feet by 12 feet in section, others 8 feet by 12 feet. In building the larger size piers, some of which extend 17 feet above the bottom, two caissons were used, one superimposed on the other.

The lower caissons were 9 feet 6 inches in height with a 6-inch bottom of concrete placed at such a height as respects the side walls as to leave a cutting edge, as it were, of 12 inches in depth. The side walls of the caisson were also 6 inches thick. The bottom slab is stiffened by two concrete beams 4 inches wide, 30 inches deep, placed at right angles on the centre lines of the caissons. The upper rim of the caissons was built with an internal offset of about 6 inches, so as to permit the upper section of the completed pier to fit down over the lower section and thus be held rigidly in place. The offset was 12 inches in depth.

The upper caissons were also 9 feet 6 inches in depth, lapping 1 foot on the lower caissons, thus making the total height of the entire concrete pier 18 feet, the cutting edges protruding 1 foot into the bottom. The upper caissons were built without a bottom, but have internal bracing beams or struts 4 inches in width, and 24 inches in depth.

The smaller caissons, 8 by 12, have only one internal partition 4 inches wide, 24 inches deep, with walls 6 inches thick. The walls and bottoms of the caissons were reinforced on both sides, as is necessary in this class of work. Special attention was also given to the cement and its chemical properties. All the caissons were built on shore, put afloat and placed in position by filling the interior with ballast. The upper parts were set in place by mechanical power, as they possessed no floating capacity on account of having no bottoms.

Huntington Bay, N.Y.—During the summer of 1910 recourse was had to a floating concrete caisson in constructing the foundation of a lighthouse built by the Government at the entrance to this harbor. The caisson measured 26 by 30 feet, being 16 feet in height. It was divided into four compartments by means of two interior walls. The exterior walls were 16 inches thick, the interior walls 12 inches thick, heavy fillets being worked at the intersections of the various walls and bottom slab. Both surfaces of the walls of the entire structure were reinforced according to the hydraulic pressure they had to withstand. The vertical bars had the same spacing throughout. A 1:2:4 concrete mix was used.

In the construction of the caisson on the shores of the bay, proper blocking was placed so as to be under the outside walls, as well as under the longitudinal centre line partition. Eight by twelve timbers were then placed upon the blocking in a level position with a 4-inch wooden flooring worked on top. A wooden sub-base was thus formed to the caisson itself. To secure the timber structure to the concrete caisson large lag screws were screwed partly into the 4-inch flooring, 2 feet on centres across the structure, 1 foot on centres longitudinally. The concrete bottom and the walls were then constructed with the proper reinforcement on the timber platform in the usual manner without any interruption in the pouring, thus resulting in a monolithic structure. After the forms had been removed, the exterior walls were given a heavy grout coating.

Owing to the small excess of buoyancy when afloat, the caisson was built in an upright position. After sufficient curing the caisson was launched overboard by means of the usual launching ways and later on towed about ½ mile to its final resting place, where it was sunk on a prepared bottom. Since the completed structure drew 1½ feet more than the depth of water over its final location on the bar, it was necessary to resort to several means to decrease its draft so as to permit of it being properly placed. This was done by pumping air into the pockets formed by the 8 by 12 timbers on the underside of the timber base and partly by bodily raising the structure by a derrick, the caisson then being dragged into position by means of tugs. The four interior pockets were partly filled with water to act as ballast until the placing of the interior concrete fill. Riprap was also placed around the outside of the caisson immediately after setting, to protect it against storms. Afterwards the interior pockets were filled with a 1:3:6 concrete placed in the dry, the work being carried on in two pockets simultaneously and alternately to a depth of 5 feet at a lift. The concrete superstructure of suitable design was then erected. The weight of the caisson was about 315 tons, 290 tons being of concrete, and 25 tons of steel reinforcement.

General Considerations.—Before concluding this article it is fitting to point out a few facts as recommended by those best experienced in the use of concrete floating caissons.

Since the caissons are apt to plunge low in launching unless long and expensive ways are used, the maximum stresses are usually experienced during launching and can be so considered in designing the structure.

While it is possible to launch concrete caissons ten days after the manufacture in fresh water work, it is perhaps better to wait a much longer period when the caissons are to be subjected to sea water action, to ensure their absolute permanency.

Concrete caissons possess great stiffness and substantial strength, which permits of their being towed long distances in rough water without danger.

The constructing of concrete caissons at a more or less permanent yard permits of the installation of a suitable plant and the organization of a good working force, both of which will tend to materially reduce the cost of manufacturing and launching the caissons and also the total cost of the proposed structure.

While in small caissons it is best to have them mono-cellular, in order to decrease their dead weight without making the side walls too thin, in large caisson work it is best to have numerous chambers or compartments, since the cross walls can be made of substantial thickness without any appreciable effect upon the buoyancy. Still, it is not believed that in many cases it would be true economy to use caissons which would be lighter in weight than conditions of buoyancy require.

Since it is possible to sink the caissons quickly to position by means of water ballast, they become safe against moderate wave action in a very short space of time after arriving at their final resting place. When sunk the tops of the caissons project above water, thus permitting of the compartments being pumped out in rotation and the interior fill placed in the dry. This affords a cheaper and more substantial system of permanent subaqeuous construction than any other mode.

With the cost of timber slowly advancing and temporary structures becoming things of the past except in undeveloped countries, permanent concrete construction is rapidly advancing to the front. While there is probably much to be learned about reinforced concrete floating caissons, and much educational work to be done among contractors, in no other field (of engineering), apparently, will reinforced concrete make greater strides in the immediate future than in such works as breakwaters, piers, dock-fronts, revetments, bridge piers and similar structures where reinforced concrete caissons may be employed.

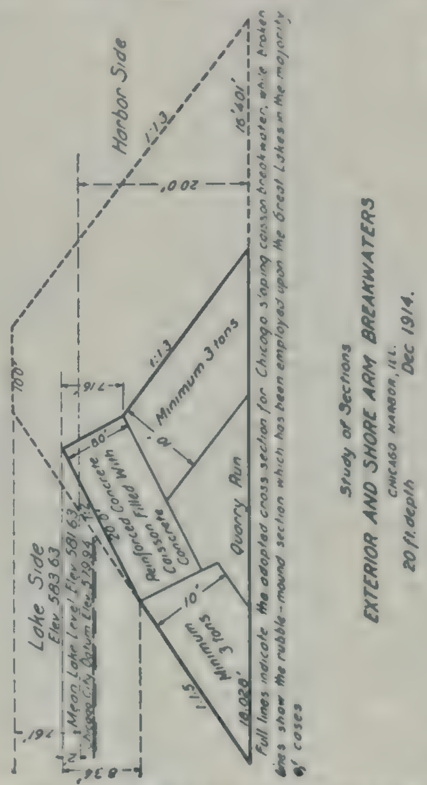

Harbor Side
1:1.3
200'
18.40'
100'
9.16'
8.0'
Minimum 3 tons
1:1.3
9'
20.0' Concrete
Reinforced Concrete Caisson filled with Concrete
Quarry Run
10'
Minimum 3 tons
1:1.5
18.02'
Lake Side
Elev. 583.63
Mean Lake Level Elev. 581.63
Chicago City Datum Elev. 579.94
26.1'
2'
8.36'
Full lines indicate the adopted cross section for Chicago sloping caisson breakwater, while broken lines show the rubble-mound section which has been employed upon the Great Lakes in the majority of cases
Study of Sections
EXTERIOR AND SHORE ARM BREAKWATERS
CHICAGO HARBOR, ILL.
20 ft. depth
Dec 1914.

Fig. 6.

Concrete caissons used in a sloping position on Chicago Harbour breakwater.

From the great advantage to be derived from floating concrete caissons in harbor development, it would seem that this branch of concrete engineering will find a wide field of applicability now that the use of concrete in sea water is more thoroughly understood by American engineers. In view of the success obtained in foreign countries and the wider use of the system being made yearly, it would seem that with an unrestricted use of the system in the United States upon the expiration of Colonel Judson's patents, the use of floating concrete caissons will be more widely adopted by United States engineers, for if they have been successfully used in deep foundation work why not in hydraulic engineering?

The Use of Oxy-Acetylene Equipment in Welding and Cutting

THE following notes are based on data compiled by The Travelers' Insurance Company (Engineering and Inspection Department), Hartford, Conn. Particular attention may be drawn to the paragraphs relating to the precautions necessary to avoid mishaps in the manipulation of acetylene generators and oxygen containers under high pressures, and to minimize the danger to the bodily well-being of the workman using high-temperature gas flames in the welding and cutting of metals.

The ordinary method of welding, and the one that has been in common use for many years, is that known as the compression process. By this method the pieces to be welded are heated in a forge to a temperature slightly above the proper degree for welding. The two ends, after being treated with a suitable flux to decrease scale and shut out air, are placed together, and a compressive force, usually created by hammering, is depended on to form a junction. The smith must be able to judge the proper temperature for welding, make sure that the flux is applied properly, and then hammer the adjoining ends so that slag, scale and air are forced out. It is evident, then, that the efficiency of the weld depends very much on the skill of the operator and the thoroughness with which he performs his work. This process, when properly carried out, is satisfactory for small operations, such as the ordinary work in a blacksmith's shop, but it is entirely unsuited for the demands of modern, up-to-date repair shops, where large sections of boilers, engines, and other heavy parts of metal are to be joined, because of the uncertainty of the weld and the time and labor involved.

From time to time attempts have been made to weld metals by using oxygen in combination with a combustible gas. Hydrogen, "Pintsch," and "Blau" gas have been tried, but were not found satisfactory because of temperature limitations. If sufficiently confined, the flame from any one of these would be hot enough to melt most of the common metals; but experience shows that these gases cannot be sufficiently well regulated or localized, in commercial work, to give wholly satisfactory results.

The introduction of the electric furnace has made possible the production of calcium carbide in large quantities, and from this acetylene gas is made. The combination of oxygen and acetylene, when ignited, produces the oxy-acetylene flame by over 2,000 deg. F. The extra heat generated by the oxy-acetylene flame not only melts the metals to be joined, but also fuses them so completely that they run together automatically, thus forming a weld. In addition to the fifty per cent. increase in intensity of heat in the oxy-acetylene flame over other oxygen flames, there is about 500 per cent. increase in the amount of heat. Another valuable feature of the oxy-acetylene flame is its concentration into a small volume at the working point, as compared with other flames—a condition especially suited for rapid and thorough welding and cutting.

Generation of Acetylene

Generation of Acetylene.—There are two methods for generating the supply of acetylene for welding and cutting operations—one generally called the carbide-to-water plan, and the other the water-to-carbide plan. The first makes use of a cylinder partly filled with water into which calcium carbide is dropped by a mechanism controlled by the pressure of the gas in the cylinder. This has the double advantage of producing the largest volume of gas per unit of carbide, while the gas is also separated from certain of its impurities by bubbling up through the lime water.

On the other hand, the water-to-carbide method is very apt to reduce the calorific value and the amount of acetylene produced per unit of calcium carbide, and at the same time form a tar product which will clog up the pipes, valves, and torches. For these reasons, among others, the superiority of generators of the carbide-to-water type is generally acknowledged.

Storage of Acetylene.—It is not safe to store gaseous acetylene in tanks under a pressure approaching two atmospheres; and to overcome this difficulty storage tanks are provided, containing a porous substance such as brick or asbestos, and filled with acetone. Acetylene gas is then pumped into the tanks, and this combines with the acetone, which has the property of absorbing approximately twenty-five times its volume of acetylene for each atmosphere of pressure, at 60 deg. F. By this process acetylene may be safely stored under a pressure of 150 lbs. to a square inch.

A great deal of the success of oxy-acetylene welding depends on the torch. The low-pressure, or injector-action torch, is used in connection with acetylene under a pressure of a few ounces. A chamber in the torch permits the accumulation of a small quantity of acetylene, and the oxygen passing through this chamber, under pressure, carries along a certain amount of acetylene, usually in quantities of 1 part of acetylene to from 1.6 to 1.8 parts of oxygen. This excess of oxygen, besides being wasteful of the oxygen itself and increasing the length of time required for making the weld, tends to oxidize the metal, thus forming a brittle, unsatisfactory joint.

To overcome this defect the high-pressure or positive-mixture torch was designed. In this torch both the acetylene and the oxygen are admitted under pressure, the ratio being 1 part of acetylene to from 1.13 to 1.15 of oxygen. Since both the acetylene and the oxygen are under a pressure of several atmospheres, reducing valves and pressure gauges are employed to regulate the flow of the gases in the correct proportion to produce rapid and satisfactory welding and cutting.

The Generation of Oxygen.—The quality of the oxygen has an important bearing on the efficiency of the welds, and for this reason it is essential to see that the impurities, incident to the generation of oxygen, are eliminated. This is practically impossible in a portable pressure-generator, since some of the deleterious impurities, such as chlorine, must pass through nearly 100 feet of washing fluid before they are removed. In a stationary oxygen-generating outfit, however, it is quite easy to provide the necessary amount of washing fluid, and to store the oxygen in tanks. This increases the cost of the oxygen, but, since better results are obtained, the ultimate cost of the weld is no doubt less than with a portable generator.

If portability is essential, it is recommended that both the oxygen and acetylene be obtained from storage cylinders. A portable acetylene generator has the disadvantage of requiring the removal of either the water or the calcium carbide before the generator can be taken safely from one place to another. If neither the water nor the calcium carbide is removed, and the generator tips over, the mixture of all the water and carbide will generate large quantities of gas, causing an explosion; or in case of a small leak the escaping gas may become ignited, thus causing severe burns.

Precautions for Safety.—A number of accidents have occurred due to the practice of using an open-flame light when cleaning out an acetylene generator. It is customary to wait until the pressure gauge indicates no gas in the generator before cleaning operations are started. Sometimes a small pocket of the gas remains, however, and burns the workman when ignition takes place from the open flame. Calcium carbide will occasionally cake on the sides of the generator tank, and unless the water is removed at once the caked carbide will generate gas as it is knocked from the tank, and will ignite and burn the workman. A portable incandescent electric lamp should be used instead of an open light, and the lamp bulb should be protected against breakage by a fibre or wire guard.

The tubes or hose connecting the torch with the acetylene and oxygen supply are constantly subjected to twists, turns, and abrasive action, and are apt to be so weakened that minor leaks occur, or the fastenings may become loosened and permit gas to escape. The torch itself provides a flame that will ignite the escaping gas, or the sparks from the welding or cutting operation may also light it. Occasionally gas escapes from loosened fastenings and gathers about the clothing of the man wielding the torch. Sparks from the burning metal then cause the gas to ignite, severely burning the workman. This indicates that the hose fastenings and the hose itself should be frequently inspected to see that no leaks exist or are likely to occur during an operation.

It is essential that colored glasses be worn by everyone connected with oxy-acetylene welding or cutting work. Not only should the eyes be protected from the intense light of the oxy-acetylene flame, but also from the very fine, slag-like substance that occurs during the welding operations, and which is decidedly harmful to such sensitive organs as the eyes.

Very little, if any, attention has been given to the subject of the effect of the oxy-acetylene welding upon the health of the workers. The amount and intensity of the heat from the flame is sufficient to cause evaporization of the metals, and since the workman's head must be within a foot or two of the flame he cannot avoid breathing the products of combustion unless some protection is provided. It would seem that a helmet, with a colored-glass front, would afford the necessary protection in this way, as well as protect the eyes from the intense light.

The economy and efficiency of this method of making welds and cutting metals has led to its adoption in many of our manufacturing plants, and this in turn has created an oxygen-generating industry. The cost of transportation is such, however, that the oxygen is usually sold in cylinders in which it is stored under pressures up to 1,800 lbs. to a square inch. Should one of the cylinders be defective a destructive explosion is apt to result. To guard against accidents to the workmen from this cause, the cylinders should never be stored in the working room, but should be kept in a special storage room having substantial walls. Care should also be taken to avoid leaving full tanks in places where the direct rays of the sun may strike them, or in close proximity to heating apparatus or any other sources of heat.

A New Bituminous Pavement with Pulverized Clay

DURING the last three years a bituminous pavement has been laid on several streets in Iola, Kansas, which is a mixture of asphalt cement and pulverized clay or loam. The parties developing the method have been proceeding cautiously while studying details of construction and working out machinery for treating the mineral matter entering into the pavement.

A. W. Dow, of Dow & Smith, chemical engineers, says of this pavement:

The "National Pavement" is composed of asphalt cement mixed with pulverized clay or loam which may contain more or less sand or fine stone. Owing to the strong affinity for bituminous materials like asphalt cement possessed by the colloidal silica and silicates contained in clay and clayey soils, and also to the fine state of division of the pulverized clay, a very soft asphalt cement may be used in the mixture without danger of producing a pavement too soft for traffic. In this respect it has a distinct advantage over other types of bituminous pavements, for it is a well-known fact that the softer the asphalt cement used the longer the life of the pavement, provided it is not so soft as to roll under traffic. As to the wearing qualities of this paving material, no one can say from a practical experience, but, judging from its characteristics, it is hard to appreciate how it can be worn away. The wearing cannot take place in a manner similar to the other types of bituminous pavements constructed with sand and coarse mineral aggregate. In these materials the coarse mineral matter slowly pulverizes under traffic and grinds away, but in the case of the National Pavement the clay is already pulverized to as fine a condition as possible, and there cannot be any further grinding of the particles. One great advantage which this paving material possesses over that of other bituminous pavements is that it is made of finely pulverized clay with little or no gritty particles contained in it. It will not have the same wearing effect on rubber tired vehicles, which are now so much in use on our public highways.

In constructing this pavement, a specially designed machine thoroughly pulverizes the soil which is fed into it (which may be that excavated from the road in grading), at the same time evaporating the moisture contained therein and heating all material to the degree necessary for uniform and easy mixing. The machine now in use is the third built by the company, each of the two last being an improvement over its predecessor. There are two drums, the inner of which has blades on the outer circumference. The outer drum acts as a heater. The inner revolves at a rate of about 600 r.p.m., and the blades, which are arranged normal to a helix so that the material is worked toward one end, throws the material against the outer drum. It is raised by flights on the inner surface of the outer drum (which revolves slowly), and as it falls back it is again caught by the blades, this process being repeated until all the earth is pulverized completely and comes out as flour. A screen prevents unpulverized particles from coming out. Any sand particles come out clean and bright.

The bituminous binder is then mixed with the pulverized, dried, and heated material in a regular asphalt mixer. The product as it comes out resembles pulverized rock asphalt more than it does sheet asphalt, though it can be handled in the same way as the latter. It is hauled to the road, spread, and rolled when sufficiently cool. The material which has been used as mineral aggregate is a clayey sub-soil excavated from the street to be paved. This material, which is commonly known as gumbo soil in the Middle West, is considered the most refractory soil or clay to work up into paving—yet it was readily pulverized and mixed with the asphaltic cement. Some of this pavement was laid over three years ago, and is still in good condition. Concerning it Mr. Dow says: "It is smooth, and there is little tractive resistance. At the same time it is noiseless under the hoofs of horses and sounds soft, although it does not mark nearly as badly as does a sheet asphalt pavement under the same temperature conditions. It has been subjected to considerable heavy traffic since being laid, the traffic consisting of heavy wagons loaded with dirt and with narrow iron tires." Most of the pavement has been laid on a rolled and drained earth base, although some has been laid on top of an old brick pavement. While figures of the cost were not given, it would seem that this must have been less than for a sheet asphalt pavement, since the aggregate is obtained at no expense other than that of pulverizing it. The amount of asphalt binder used to a cubic yard of pavement is almost exactly the same as for standard sheet asphalt; but, owing to the use of very fine mineral aggregate only, the combination is said to be more than merely mechanical, being more like a dense colloidal solution.

Wood-Stave Pipe for Water-Power Penstocks

By Robert E. Horton*

THAT many kinds of wood will last indefinitely when either air-dry or completely saturated is well known. In the case of wood-stave pipe the former condition is impossible, and an intermediate condition of partial saturation and partial dryness is usual. The extremely short life, even of the best selected wood, under conditions of partial saturation, especially when exposed in a warm, humid atmosphere, does not seem to have been fully realized in the earlier history of wood-stave pipe construction. As a result of experience gained, in some cases through costly failures, the conditions under which durability of wood-stave pipe may be best attained are now well known. The staves must be completely and continuously saturated; they should be perfectly sound and of the very best material; and the fibres of the wood must not be injured or broken in erecting the pipe by over-cinching or drawing the bands too tight.

Experience has shown that in the majority of cases, except where pipe is buried in soils containing acids or strongly alkaline ground-waters, the durability of the bands is greater than that of the staves. For durability the bands should be as large as is compatible with securing watertightness of the pipe and at the same time avoiding crushing of the fibre underneath the bands. The same conditions as to quality of material and coating of the bands apply as in the case of steel pipe if durability is desired.

Steel vs. Wood Pipe

Where large steel pipes are used under low pressure a certain minimum thickness of metal must be used to provide stiffness, and as a safeguard against rapid development of leakage at rust spots. For very large, thin pipes stiffening rings also are added to prevent excessive deformation of the pipe by its own weight. In the case of continuous wood pipe the economical thickness of staves required for structural reasons and to secure water-tightness is sufficient to provide adequate stiffness in most cases.

In wood-stave pipe, as in steel, the pressure is resisted entirely by metal. In the case of wood-stave pipes with bands having rolled threads or upset ends the full strength of the metal can be developed to resist tension. In the case of riveted steel pipe, especially for low heads, a large amount of metal is required in excess of that needed to resist tension due to water pressure. From considerations of economy in erection the riveted joints used for low pressures have generally relatively low efficiencies, so that only a fraction, varying commonly from 40 to 65 per cent. of the strength of the metal in the pipe walls, is available to resist pressure.

These conditions indicate an important field of usefulness for wood-stave pipe for water-power penstocks or portions of penstocks which are of large diameter and under relatively low heads. As the head increases, the joint efficiency which can be commercially realized in steel pipes is increased, and the percentage of metal added for other than tension purposes is decreased, so that for heavy pressures the amounts of metal required in wood-stave and steel penstocks would aproach equality.

The conditions determining which of these two types of penstock will be most efficient and economical in a given case are: Relative first cost or improvement; relative durability; relative cost of repairs and maintenance; and relative carrying capacity or, more properly, relative power output with conduits of a given size.

Relative Costs

The relative cost must, of course, be determined for each specific case. Large steel penstocks in the Eastern States commonly cost from 3.5 to 5 cents a pound, erected, exclusive of cradles or other supports. No simple general rules for estimating the cost of continuous wood-stave pipe can be given. The materials are mostly obtained from the Pacific Coast, and formed staves at the mills cost from about $30 to $35 a thousand feet, board measure, for Douglas fir, to $45 for redwood.

Freight is a large element in determining both the cost of wood-stave pipe and the relative economy of wood and steel. In general, the advantage of stave pipe over steel increases proceeding westward from the Eastern States, owing to reduced freight rates on wood and increased freight on steel. Formed staves take the standard lumber classification freights; freights will probably be reduced somewhat on materials for wood-stave pipe by shipment to Eastern points via the Panama Canal.

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*Consulting hydraulic engineer, Albany, N. Y., writing in Engineering Record.

Steel conduits are commonly supported on concrete cradles, though sometimes buried or partly buried in earth. The cost of wood-stave conduits is materially affected by the method of support. Support on timber trestles is usually the cheapest. For large pipe above ground concrete cradles are preferable, and the cost and spacing is about the same for wood-stave and steel pipes.

Should Wood Pipe Be Buried?

Formerly, continuous wood-stave pipes were commonly buried in the earth—first, from considerations of economy as compared with the cost of concrete or other permanent cradles; second, on the supposition that burying the pipe was conducive to its durability. Experience has shown that the staves of continuous wood-stave pipe are least durable when partially buried or when buried in porous soils, such as sands or gravels. Wood pipe is perhaps the most durable when buried below the line of saturation of the soil or in compact clay soils, where the pipe surface will be kept constantly moist by the prevention of evaporation of seepage through the staves.

Conditions where the pipe can be buried below ground-water level are very rare, and in such cases the cost of unwatering the trench during pipe construction is likely to inhibit the use of this method. Again, pipe cannot be buried where there is rock at the surface, and if buried in the soil under conditions otherwise favorable for durability the bands will be destroyed rapidly if the ground-water is either strongly alkaline or contains humic acid from the decay of surface vegetation, as is commonly the case in woods. The pipe is not accessible to repair when buried, and while apparently it is necessary to bury wooden pipe in some instances as a protection against landslides in mountainous regions, yet in the majority of cases wood-stave pipe should not be placed underground unless the conditions are all favorable, and even then only when a calculation, based on economical considerations, gives a result in favor of placing the pipe underground.

As an illustration the calculation in Table 1 is given, in which it is assumed that the life of the buried conduit without repairs would be 15 years, whereas its life above ground, properly maintained and repaired, would be forty years.

Table 1.—Illustration of Relative Cost of Buried and Unburied Pipe

Condition	On Crades	Buried
Cost of pipe per foot	$13.60	$15.50
Cost cradles or trench	$6.40	$1.50
Total investment	$20.00	$17.00
Life, years	40	15
Repairs, per cent. per year	1	0
Annual Charges		
Interest, at 6 per cent.	$1.20	$1.02
Depreciation:		
At 2½ per cent.	$0.50	.....
At 6 2-3 per cent.	.....	$1.02
Repairs	$0.20	$0.00
Total annual charges per foot	$1.90	$2.04

The comparison given is for pipe 9 ft. in diameter under an average head of 60 ft. It is assumed that the pipe above ground is supported by concrete cradles. This increases the first cost per foot materially over that for the buried pipe, but even then, owing to the rapid depreciation of buried pipe, the calculations show the total annual charges per foot of pipe to be considerably less for the pipe supported above ground on cradles.

It is generally conceded that the carrying capacity of new wood-stave pipe with a given friction loss is somewhat greater than that for new riveted steel pipe. There is some diversity of opinion as to the amount of difference. The writer believes that the later formulae for the capacity of these two classes of pipe are substantially correct, and that there is a material difference in favor of wood-stave pipe when new as compared with steel when new. Of the two, steel pipe is also subject to much the greater increase in friction head or decrease in carrying capacity with increased age. Probably the Hazen and Williams formula represents the best determination of the carrying capacity or friction head for steel pipes. The Moritz formula is probably the best available for application to large wood-stave conduits. In a somewhat later review of the experiments Andrew Swickard gives the formula

$$n = (D/30{,}000) + 0.0105$$

where n = coefficient of roughness to be applied in the Kutter-Chezy formula, and D is the inside diameter of the pipe, in inches. This formula is convenient for those who prefer to work from the Kutter formula or diagrams based thereon.

For pipes 9 ft. in diameter, with velocities of 6 ft. per second, the friction head is as follows:

Riveted steel pipe, Hazen and Williams formula, with $C = 110$, friction head 1.06 ft. per thousand.

Riveted steel pipe 10 years old, Hazen and Williams formula, with $C = 100$, friction head 1.26 ft. per thousand.

Wood-stave pipe, Hazen and Williams formula, with $C = 120$, friction head 0.9 ft. per thousand. With the Moritz formula the friction head equals 0.60 ft. per thousand.

The friction loss by the Moritz formula is considerably less than by the Hazen and Williams formula. The two results may be reconciled in some degree by considering that Moritz's formula applies to new pipe properly constructed and in the best condition, whereas friction head given by the Hazen and Williams formula would, in the writer's opinion, only apply to average pipes in service as heretofore constructed, many of them being improperly constructed and in some cases subject to deposits of sand and sediment in the pipe inverts. Even when free from sediment and properly constructed, the carrying capacity of wood-stave pipe may be reduced somewhat by growth of slime and spongilla on the interior surface, which slightly decreases the effective diameter and increases friction by throwing off small eddies, although not decreasing the apparent smoothness of the surface.

In comparing the merits of steel and wood pipe conduits for specific cases, the relative carrying capacities should be taken into consideration, as illustrated by the example which follows. The relative cost or value of conduits of different materials having different degrees of roughness is sometimes arrived at by estimating the difference in cost of conduits which are of different sizes but which will carry equal quantities of water with the same total loss of head. In the writer's opinion this method is not generally applicable in the case of conduits for power purposes. In such cases there is usually a maximum permissible velocity determined by conditions of speed regulation or governing. Economy dictates that whatever material is used the fixed maximum velocity should be equalled but not exceeded. Accordingly the conduit should be of the same diameter, in the majority of cases, regardless of the material or friction loss per foot of length. If the velocity is the same in both and the friction loss in wood-stave is less than in steel pipe at the given velocity, the average net head available at the power plant will be greater if the wood-stave pipe is used, and the market value of the average increase in power so obtained is one of the items to be considered in determining the relative economic values of the two types of conduits.

Power Gained by Reduced Friction

The gain in power should be estimated from the increase in head available with the plant operating at its average load, not at its maximum load. The power gained by reduced friction in the conduit is obtained at very little expense. The power and speed of the turbine are increased by increased head. Generator costs are smaller per unit at the higher speeds, and there would be no material difference in attendance or overhead charges in the two cases.

Instead of calculating the gain in marketable power due to increased head as clear profit, it is perhaps safer to estimate the value of the increased power pro rata the same as the value of the average power output of the plant.

Relative Economy of Wood and Steel

Table 2 shows a comparative estimate of the cost of wood-stave and steel penstocks each 9 ft. in internal diameter and 2,000 ft. long. The figures are based on recent bids for a conduit in central New York. In this case the computation shows some apparent economy in favor of wood-stave pipe regardless of increase in power. It will be noted that taking into account the increase in power, the result of such a calculation may indicate that it is an economical advantage to use wood-stave pipe even where the first cost is equal to or a little greater than that for steel pipe.

Table 2.—Illustration of Method of Determining Relative Economy of Wood and Steel Conduits

	Steel Pipe	Wood Stave Pipe
First cost of pipe	$17.40	$13.60
Concrete cradles	6.00	5.00
Total investment	$23.40	$18.60
Life assumed	40 yr.	30 yr.
Depreciation rate	2½%	3 1-3%
Repairs	0.5%	1%
Annual Charges per foot of Pipe		
Interest and taxes at 7 per cent.	$1.638	$1.302
Depreciation	0.585	0.620
Repairs	0.117	0.186
Total	$2.340	$2.108
Total for 2,000 ft. conduit	$4,680	$4,256
Value of power gained, 25 h.p. at $10 per h.p.-year	00	2.50
Annual balance	4,680	4,006
Net saving with wood pipe		$594
Capitalized saving at 8 per cent.		$7,425

In the case on which the figures given are based, wood-stave pipe was not used, in spite of the economic showing in its favor, because of the general feeling of uncertainty then prevalent regarding the durability and conditions tending to produce long life for wood-stave pipe. It is highly desirable that the conditions governing the durability of wood-stave pipe should be more generally understood and accepted:

First, to prevent repetition of serious mistakes of the past, where wood-stave pipe has been used under conditions to which it was not well adapted.

Second, to prevent its rejection in cases where it clearly shows a decided economical advantage over steel.

Wood-stave pipes have been used for casings of artesian wells in oases in northern Egypt for more than 2,000 years. These pipes are placed within square timber curbing, and the space between the square curbing and the pipe is packed with clay. Under these conditions the staves are always saturated. It could hardly be expected that the wood from which these Egyptian pipes are constructed (acacia nilatica) would last more than a decade if exposed to the air and partially saturated.

Complete and perpetual saturation of the staves being the prime requisite, to secure durability care should be taken that the thickness of the staves is not too great in proportion to the pressure. If durability is desired, wood-stave pipe should not be used unless it will be continually filled with water under a static pressure head of from at least 20 to 30 ft. The staves are made from stock sizes of timber, and their exact size and thickness for a particular case are governed by the smallest commercial size of board from which the stave can be cut. This is best determined by an accurate full-size drawing of the stave section. Thickening the staves increases the stability of the pipe against deformation, and generally is conducive to water-tightness at the joints or seams. The staves should not be so thick as to prevent a reasonable amount of percolation through the pores of the wood under pressure. To meet these conditions the following formula was devised by the writer for use in preliminary determination of stave thickness:

$$T = 1 + h/100 + d/100$$

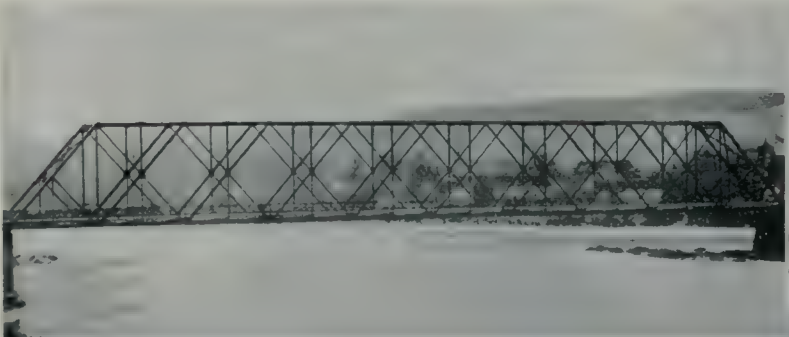
where T = thickness of staves in inches; h, head in feet; d, diameter of pipe in inches. It is believed that staves determined by this formula will have the maximum of durability consistent with reasonable stiffness of the pipe.

Light Highway Bridges

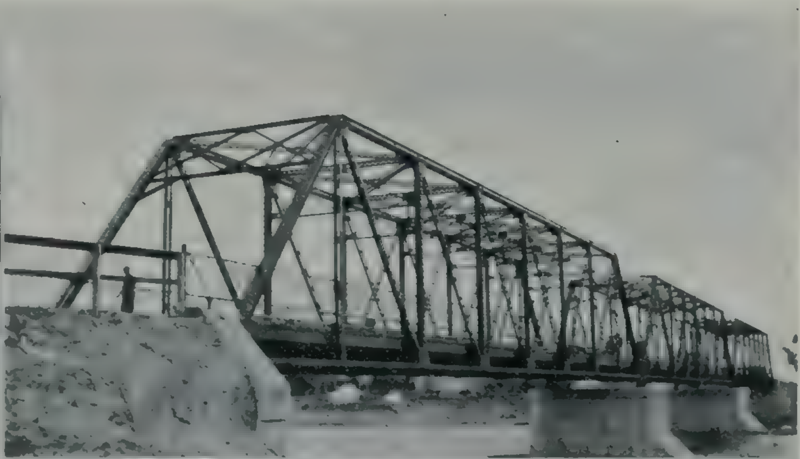
IN addition to the larger and heavier bridges necessitated by the traffic increase and gradual expansion of the larger towns and cities, there is a growing demand for steel spans in the smaller towns and municipalities. These are generally for the lighter kinds of service and are often built under subsidy from Provincial Governments or even by these Governments direct. The Provinces of the Dominion have their own specifications in every case for this class of structure, and these specifications differ considerably in different places. In the Province of Quebec a number of bridges for country and small town traffic have been built, and in recent years the majority have been designed to meet the Provincial specifications drawn up by Mr. L. A. Vallee. A number of typical light highway spans are illustrated herewith.

The two spans at Richmond, Que., were built in 1903 and still enjoy the distinction of being the longest riveted highway spans in existence. They are 370 ft. 10 ins. long, 20 ft. wide, and 40 ft. deep. The flooring is of wood, as are also the stringer joists. The floor is designed to carry an 8-ton wagon or 100

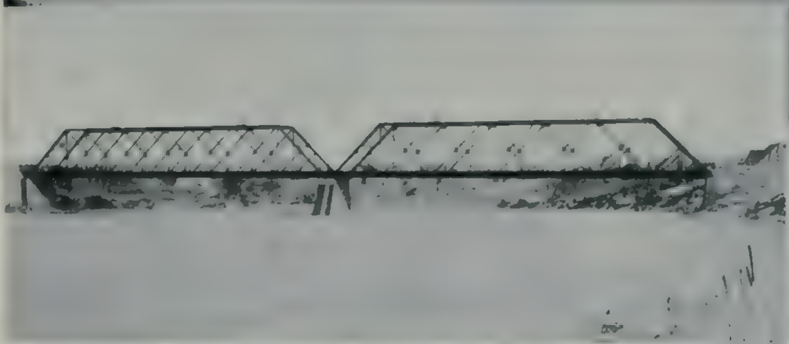
Light Highway Bridge Designs



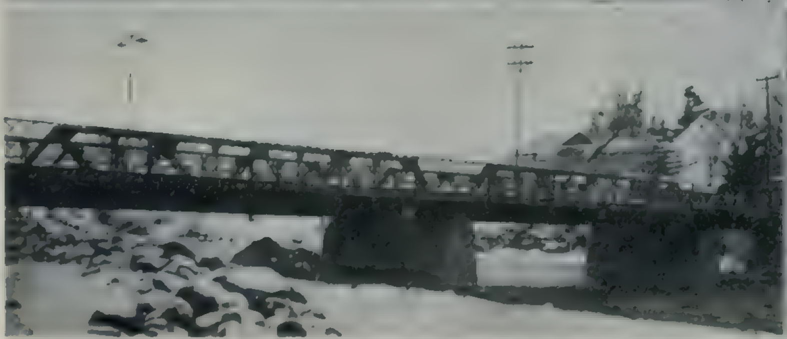
At Richmond, Que.



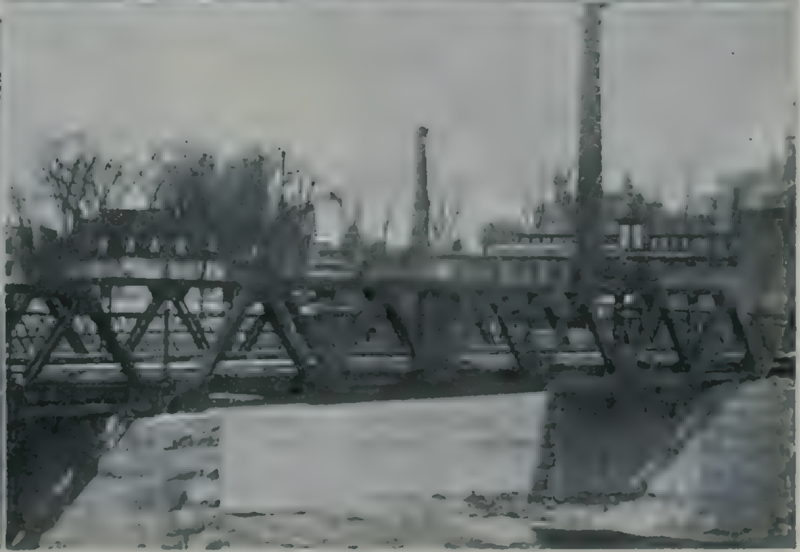
At Drumheller, Alta.



Centre illustration on left is at St. Hyacinthe, Que.

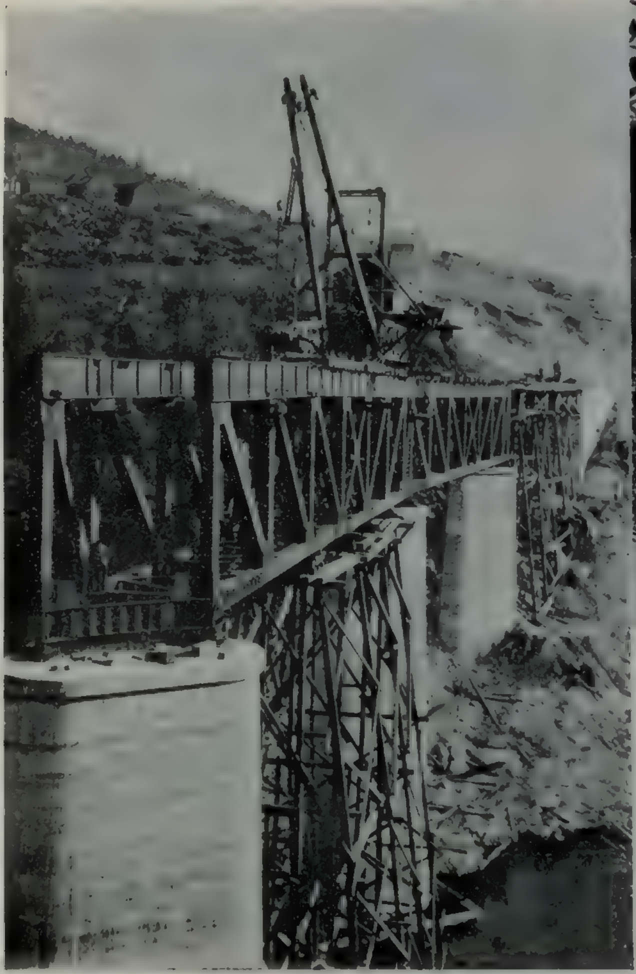


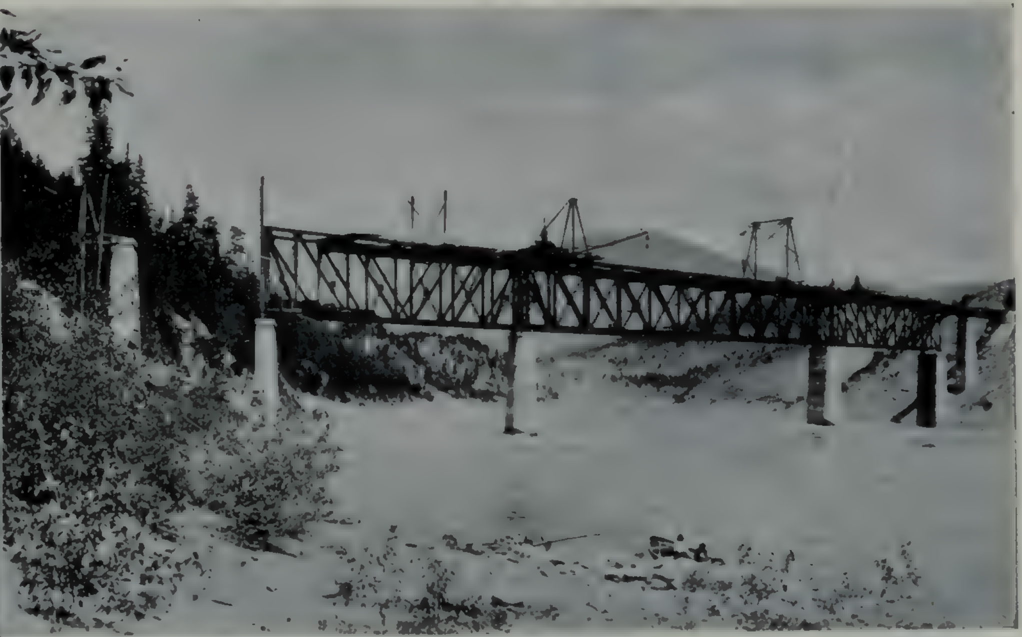
At Magog, Que.



At St. Hyacinthe, Que.

Two Canadian Northern Bridges in British Columbia





These illustrations show two of the bridges completed in 1914 on the line of the C. N. P. R. in British Columbia. The photograph on the left is of Bridge No. 3 over the Thompson River near its junction with the Fraser, while the other picture shows Bridge No. 2 over the Fraser just south of the junction of the Thompson River. Both were built to the designs of Messrs. Waddell & Harrington and consist mainly of deck truss spans on very high concrete piers. Bridge No. 2 contains about 1,346 tons of steel, and there are 733 tons in Bridge No. 3. The illustrations are published by courtesy of the Dominion Bridge Company, who erected these spans.

pounds per square foot. The trusses are designed for a load of 60 pounds per square foot. Each span weighs 189 tons.

The Barsalou Bridge at St. Hyacinthe, Que., includes the two spans shown in the cut, which were built in 1914. They are 81 ft. and 91 ft. in length respectively, and weigh about 29 tons and 34 tons. Each is designed to carry a 20-ft. road with a loading of 100 pounds per square foot, and two sidewalks. The floor system is able to carry 15-ton wagons.

The Morrison Bridge, also at St. Hyacinthe, consists of two through truss spans 210 ft. long, built with an 18-ft. roadway for loading similar to that of the Barsalou Bridge. The weight of steel in each span is 113 tons.

The bridge over the Magog River at Magog, Que., is of the pony truss design with an 18-ft. roadway to carry a 20-ton wagon. It has one sidewalk and the flooring and stringers are of timber.

The Drumheller Bridge at Drumheller, Alta., was built for the Alberta Government in 1914. It consists of three spans of about 150 ft. The bridge was fabricated in the Winnipeg shop of the Dominion Bridge Company, and is representative of a number of bridges made there for the West.

Cost of Trench Work Through Brick Pavement for Wire Conduit

THE trench in point was as near as possible to the curb, and crossed under two sets of street-car tracks and two street intersections, says a writer in Engineering and Contracting. The costs given are for tearing up brick pavement down to grout base, trenching sand cushion and replacing same, relaying brick pavement and slushing with cement filler for laying a wire conduit for ornamental street lights. They also include the cost of sixteen 1 ft. 4 in. square holes about 16 ins. deep, cut through cement and stone sidewalks, filling these holes with concrete, and setting four base bolts in each hole. The cost for the post holes, etc., was as follows:

Item	Total	Per hole
Labor cutting, 25 hrs. at 50 cts.	$12.50	$0.78
Labor concreting	5.00	0.31
Total labor	$17.50	$1.09
12 wood templets for base bolts	3.00	0.19
2 cu. yds. concrete at $3.60	7.20	0.45
Miscellaneous	1.12	0.07
Total materials, etc.	$11.32	$0.71
Grand Total	$28.82	$1.80

The cost of the trench 1½ ft. wide and 1,130 ft. long was as follows:

Item	Total	Lin. ft.
Tearing up and cleaning brick	$21.37	$0.019
Relaying brick	27.95	0.025
Teaming	4.00	0.004
Total labor	$53.32	$0.048
2 cu. yds. cushion sand	3.00	......
4 bbls. cement	6.00	......
300 new brick	4.00	......
Miscellaneous	5.00	......
Total materials	$18.00	$0.016
Grand total	$71.32	$0.064

Carrying Concrete Road Over Trenches with Soft Backfill

IN constructing concrete pavement at Elizabeth, N.J., soft filling of old gas, sewer, and water trenches in several places proved impossible to compact by roller to the solidity of the approach sub-grade. To excavate and refill would have been costly, and recourse was had by the engineer to a method of bridging. He excavated the whole intersection 3 ins. in excess of the contract requirements, rammed broken stone in the trenches and when sufficiently dry applied 9 ins. of concrete over the whole surface thus prepared. The specifications were not exactly followed by so doing, but the sub-grade was prepared in such a manner that the extra concrete would bridge the trenches in a satisfactory manner. To make repairs to the road when cut through for future trenches a somewhat similar construction is planned, as follows: The concrete will be cut 6 ins. wider on each side than the excavated trench, and will be excavated 3 ins. below the sub-grade on the shoulder; the refill must be made as compact as possible. The old concrete must then be cut as a skew back on each side so that the opening is 4 ins. wider at the top than at the bottom. Number ten expanded metal or its equivalent of ½-in. steel bars are to be placed 2 ins. above the newly prepared sub-grade; the space is then to be filled with concrete while the sides of the old pavement are fresh cut and clean. After setting a sufficient time, while guarded against traffic, it is to be recoated with bitumen.

Expansion joints will be repaired with a suitable brand of hot paving pitch, poured into the joint after it has been cleaned of loose foreign material, and the edges cleaned by chisel or other suitable tool, after which it will be filled with ½-in. gravel and then allowed to set.—Engineering and Contracting.

Canadian Northern Railway Bridges in B.C.

AT Kamloops, B. C., the Canadian Northern Railway recently completed their girder type lift bridge across the North Thompson River. This fine bridge, which is 1,209 feet long, with approaches making 1,123 feet additional, is unique in Canada, it being the first bridge in the Dominion having a vertical lift span. The lift span, which is 93 feet long, can be raised vertically to 55 or 57 feet above high-water level. It was designed by Messrs. Waddell & Harrington, consulting engineers, Kansas City, Mo.

The lift span, consisting of a 93-ft. deck plate girder, weighing about 236,000 pounds, is balanced by counter weights attached to cables which pass over sheaves at the top of the towers. There are four 1¼-inch cables at each corner of the span, and equalizers are used on the span side to distribute the load properly to each rope. The span is guided along the sides of the front tower columns during its movement, the guides being detailed so as to allow proper movement at the expansion end under temperature and live load changes. The counterweights, likewise, are guided along the sides of the towers.

Centring castings are used at the ends of the span to bring the span in proper alignment when it is seated. These castings also take the thrusts from moving trains. Special rail castings are used at the ends of the lift span to give continuity to the rails at these points when the span is down, and at the same time locks are provided for each end of the bridge. The span is raised and lowered by means of cables fastened at the top and bottom of the towers.

These cables pass over drums at each corner of the span, which are actuated by a number of gears and shafts connecting to a gasoline engine at the centre. All the machinery is below the deck except the operating levers and indicator, which are located in the operator's house, supported at the level of the deck from the side of one girder. A limit switch is used in the igniter circuit to cut off the engine after the span has passed a certain point in both its up and down movements. Contacts are likewise placed on the clutch level so as to control the igniter circuit in conjunction with the limit switch. A hand-brake is installed with the machinery for manual control of the engine.

Arch bridge at Cisco Canyon, Fraser River.

The greater part of the machinery is enclosed between the girders just below the deck at the centre of the span, and is accessible from the operator's house by means of a stair and door through one of the girders. Hand operation is also provided for. The machinery is designed to lift the span 53 feet in 100 seconds, providing a clearance of 55 feet above high-water. Though the Kamloops Bridge is the first of its type yet built in Canada, the St. John and Quebec Railway will erect a similar one across the Oromocto River near Fredericton South, N. B.

There are only two other bridges of this type yet in operation—one is over Pond Oreille, at Sand Point, Idaho, and the other is over the Big Choctaw Bayou, in Louisiana. This bridge on the Louisiana and Texas Railroad carries single-track traffic. It has a 50-foot lift span of the through-plate girder type, which is fully balanced by concrete counterweights and is operated by hand by one man. This span can be raised to the full height of 47 feet above high-water in ten minutes. The piers are of concrete on pile foundations, as in the Kamloops Bridge.

It is claimed for the vertical lift bridge that it is a simple span in which all stresses are determinate, and similar to those of a fixed span. It is economically adapted to skew crossings, to construction on a grade, and to future change of elevation of grade; it is as rigid as a fixed span; it may be paved like a fixed span; and since the floor is always horizontal, spans of any length may be built, and the longer the span the greater the comparative economy of the vertical lift bridge. The wind has no effect upon the towers or span, for they expose small areas to it. The span is fully counterweighted, so that the operating machinery has only to overcome friction and inertia; and but one operator is required, no matter how large the open channel.

High Level Bridge at Cisco, B. C.

Herewith is shown a view of Bridge No. 1, crossing the Fraser River, B. C., five miles down stream from Lytton, at mile 140 east of New Westminster Bridge. The view is from the up-stream side, looking towards the C. P. R. Cisco Bridge, shown in the distance.

This bridge, starting from the west end, is composed of one 77-ft. deck-plate girder, one 40-ft. tower, one 81-ft. deck-plate girder, one 40-ft. tower, one 106-ft. deck-plate girder, one 425-ft. arch span, and one 40-ft. deck-plate girder span at the east end of the bridge. The total length is 809 ft. Erection was carried on from both ends. The arch span was erected by a cantilever system from both ends. The material and derrick for the east half of the span were taken across to the east side of the river by means of a cable. The height of the bridge above low-water is 198 feet.

Five wells in the southern part of the Province of Alberta have now produced oil in greater or less quantities. The results show that the oils are of a varied nature and that they compare favorably with oils from some of the well-known fields of the United States.

A new type of lift design at Kamloops, B.C.

Personal Mention

Lieut. R. F. Morkill, Signal Engineer of the Grand Trunk Railway, who is now at the front, has been promoted to the rank of Captain.

Mr. E. J. Holland has resigned his position as City Engineer of Guelph, Ont., and the City Clerk has been instructed to advertise for a new City Engineer.

Among the Montreal officers mentioned by Sir John French for gallant service in the field is Lt.-Col. F. O. W. Loomis, of the firm of D. G. Loomis and Sons, contractors, Montreal.

Mr. Louis A. Amos, architect, of Montreal and Lachine, Que., has been elected Mayor of Lachine, in succession to the late Mr. J. T. Rathwell. Mr. Amos was elected Alderman in 1913, and was Chairman of the Public Works Committee.

Messrs. Tetley & Doggart, architects, formerly of 78 Crescent Street, Montreal, have dissolved partnership, and Mr. C. R. Tetley, A. R. I. B. A., is practising his profession alone, with offices at 304 University Street. Mr. Doggart has gone to Milwaukee, Wis.

Mr. George S. Hanes, Mayor of North Vancouver, and former City Engineer of Windsor, Ont., was a visitor to that city recently. He congratulated the City Council on the many improvements that had been made in the city, and said that the factory district of Windsor was a move in the right direction.

A meeting of the Royal Institute of British Architects held in London, England, on June 21st was made the occasion of the presentation of the Royal Gold Medal for Architecture to Mr. Frank Darling, of Toronto. As reported in our issue of March 17 last, Mr. Darling is the first architect of any of the overseas dominions of the Empire to receive this medal, which is the highest architectural honour to which any architect in the world can aspire. As Mr. Darling was unable to be present in person, Sir George Perley received the medal at the hands of President Newton of the R. I. B. A. Among the Canadians present at the meeting were Donald MacMaster, W. L. Griffith, Dr. Armour, and A. G. Colmer; and there were also representatives from the other overseas dominions.

Mainly Constructional

East and West From Coast to Coast

Curtis Brothers' brickmaking plant at Peterborough was badly damaged by fire recently, when practically all of the machinery was ruined and two frame buildings were completely destroyed. The loss is not covered by insurance.

Considerable activity is noted in municipal work at Hull, Que. Plans have been prepared for a water-main system to cost $116,000, and tenders will be called shortly. Plans have also been drawn for a sewer to be constructed in the city.

In connection with their underground conduit scheme, the city of Montreal are installing an electric fire alarm system on St. Catherine and Bleury Streets and Park Avenue. The contractor will supply and install all the cables, fire alarm boxes, pedestals, etc.

A branch of the Canadian Society of Civil Engineers has been organized in Regina. At the initial well-attended general meeting the following officers and executive committee were appointed: Chairman, O. W. Smith; Secretary, L. W. Wynne-Roberts; Executive Committeee, A. J. McPherson, F. McArthur, and I. N. de Stein.

Montreal building supply houses report a slight improvement in business. The brick trade is looking up, and some orders have been booked for Newfoundland and the Maritime Provinces. A fair amount of building is going on in the province of Quebec, and a satisfactory proportion of the supplies are ordered through Montreal firms.

Before accepting bids for paving blocks the Montreal Controllers made minute inquiries from the representatives of the firms tendering as to the prices at which similar goods had been offered in Toronto. It has been freely stated that, apart from differences in freight, Toronto has been able to secure such materials as paving blocks, asphalt, etc., at lower prices than Montreal.

From Calgary, Alta., comes the report that work will be recommenced on a nine-storey block of offices and stores there. The foundations, steel work and concrete floors were done two years ago, and preparations are being made to enclose the building and to finish five floors. As the total cost of the building is placed at $325,000, the report is rather encouraging as regards the condition of constructional activities in the West.

The sub-contract for steel for a new bridge at Stadacona Road, Quebec, Que., has been let to the Eastern Canada Steel & Iron Works, Limited. The bridge will consist of two spans, 80 ft. and 70 ft. long respectively, on a concrete substructure. The width of the bridge will be 25 ft. and a 4-in. red pine floor will be laid. The cost of the structure is estimated at $116,000.

At Renfrew, Ont., the Jamieson Brick and Tile Company have decided to operate another brick and tile yard. They have been having tests made of clay on certain lands, and as this has been found of suitable quality the company will erect machinery and kilns on this site. It is understood that some new lines of manufacture will be undertaken in connection with this expansion of the business.

The bondholders of the Ontario National Brick Company, Limited, will meet in Montreal on August 17 to consider a plan to cancel the interest coupons for 1915, 1916, and 1917, accepting in their place bonds of the current series aggregating at their par value the amount of the coupons maturing for the three years, plus interest at 6 per cent. per annum on that amount for a year and a half.

Toronto is still looking for a start on the building of its new Union Station "the first of next month." The rumour that the C. P. R. was about to withdraw from the Terminal Company and abandon its part of the work has been denied by officials of that company. It is understood that the railways consider the building of the new station "a useless expenditure" at the present time. According to the last order of the Dominion Railway Board, the station must be completed by July 29, 1916. It is stated, however, that it would be impossible to build the station in less than three years, although it might be opened to the public in two and a half years.

The front of the new Post Office at St. John, N.B., has been uncovered, and it is expected that the interior will be finished and the building be ready for occupation in a few months. The first storey of the front is finished in gray granite, and the remaining three storeys in freestone. The ground area is about 150 x 100 feet. The cost of the structure is estimated at $390,000.

Seven tenders have been received for the construction of a new storage dam on the St. Lawrence River, for the Quebec Streams Commission. The dam will be situated at La Loutre, about a hundred miles north of the new railway development. It will be over 1,000 feet long, and its depth at the deepest part will be 85 feet. The area to be flooded will constitute one of the greatest reservoirs in America.

The reinforced concrete floor of the new bridge at St. John, N.B., is nearing completion. This part of the work was delayed last fall by severe frost. The city approach is complete, and the contractor expects to commence work on the Carleton Street approach immediately. The trimming of the bridge will not be completed until after the old bridge is removed. It is stated that the new bridge will be ready for traffic early in August.

The new public building at Brantford, Ont., was opened recently, it having been finished within the time specified. The building consists of four floors, and cost approximately $300,000. It is occupied by the Post Office, Customs, Inland Revenue, and Indian Affairs Departments. The contractors were P. H. Secord & Sons, and the work was carried out under the supervision of Mr. C. W. Hall, the architect. Mr. J. Graham was Clerk of the Works.

The construction programme brought down by the City Commissioners at a recent meeting of the City Council of Regina, Sask., provides for a total expenditure of $278,961. The details of construction include: Works, $177,927; sewage disposal works, $10,500; domestic sewers and water-works, $60,282; street railway, $10,000; Health and Relief Department, $1,655; and Light and Power Department, $29,117. The estimates include also provision for water-main extensions in certain parts of the city. The Commissioners do not think that the amount must of necessity be spent this year.

After having awarded a contract for resurfacing asphalt roads to the Simplex Paving Company without having called for tenders the Montreal Board of Control discovered that they had exceeded their powers, and notified the Council that they withdrew their report on the subject. Notwithstanding this, the Council by a majority awarded the contract to the company. The City Attorney has now decided that this action is illegal, as the granting of contracts is solely within the jurisdiction of the Controllers, and, besides, the Council cannot act on a report which has been annulled. The Controllers, therefore, will call for new tenders.

Notice has been received by the London Industrial Bureau that the annual convention of the Ontario Architects' Association will be held in London during fair week. It has also been decided that the Association's annual exhibition which is held at the Toronto Industrial Exhibition every year is to be forwarded to London and exhibited at the Western Fair. John M. Watt, of Watt & Blackwell, architects, is Chairman of the exhibition committee of the Association, and has been working for the last five months to secure this convention and exhibition for London, the matter having been decided at the regular meeting of the council of the Association held in Toronto recently.

Representatives of the municipalities interested in the Toronto-Oshawa road are to meet in Toronto to advance the project. It is likely that one result of the meeting will be the submission of a request to the Ontario Government to bring into effect the Highway Bill passed last session. It is stated that the Government has decided not to assume any financial obligations under the Act this year, but there is nothing to prevent its being brought into effect this year. In this case the municipalities may get all their plans ready for a start on actual construction next year. The counties now carrying on road construction under the 33 1-3 per cent. grant from the Government will not obtain the increase to 40 per cent. until next year, it is understood, even if the Act is brought into force earlier.

According to a Quebec despatch, a company has been incorporated under a provincial charter, with a capital of $3,000,000, to develop and supply hydro-electric power in the cities of Quebec and Three Rivers, and also to operate in several counties of the province. Three of the incorporators are Directors of the Shawinigan Water and Power Company, and two are Directors of the Dorchester Electric Company, operating in the city of Quebec. The assets of the Dorchester Company are to be sold, and the Shawinigan Company are credited with the intention of securing a controlling interest. The incorporation of the new company is apparently a move in this direction. In the event of the Shawinigan Company supplying power to the Dorchester Company it will be necessary to build a transmission line from Shawinigan to Quebec.

A dispute has arisen at Burlington, Ont., similar to that reported from Montreal in connection with tenders for paving material. At Burlington, however, the subject of the tender was sewer pipe required by the town for the installation of its new sewerage system. The town advertised for tenders for the supply of material and also for tenders for the construction of a complete sewerage system. Tenders were received and opened by the Sewer Committee, and the Engineer directed that the sewer pipe tenders be held over until he had an opportunity of reporting further. The Council, however, adopted the recommendation of the Sewer Committee, and decided to accept a tender for pipe which was $564.81 above the lowest tender. The dispute has resulted in the taking out of an injunction and a mandamus to compel the Council to accept the lowest tender or to renew its advertisement for tenders.

The City of Hull lost its appeal in the Court of Review against the lower court judgment condemning it to pay to P. Wilson et al the balance of an account in connection with drain excavations undertaken by the latter in Hull. The plaintiff sued the city for $5,016, claiming that the plans indicated earth excavation, but that when the work proceeded a portion was almost entirely rock, and he asked for the difference in the cost. The City of Hull pleaded that the contract was a fixed price; there was no representation that the excavation was earth and not rock, and the plaintiff should have satisfied himself as to the nature of the work before commencing. Chief Justice Archibald and Justices Saint-Pierre and Bruneau found that, as the plans were made, any contractor would consider that they indicated earth excavations, and there could be no question that the city knew the plaintiff was contracting for earth excavation. The defendant knew that the plaintiff valued rock excavation at $3, and at this price the plaintiff's tender would have been greatly increased.

The Controllers of Montreal have ordered plans to be prepared for the extension of the water filtration plant now under construction. Messrs. Hering & Fuller, the New York consulting engineers, have advised that the extension be of the mechanical type, increasing the daily capacity from 50,000,000 to 100,000,000 gallons. The following are the comparative estimated costs of different types under consideration for the additional filter unit: Double filtration (present type), $1,750,000; slow sand filtration, $2,100,000; mechanical filtration, $900,000. The total expenditure on the entire scheme, including the widening of the aqueduct, will be $4,500,000, made up as follows: Expropriation of land and retaining wall, $225,000; fencing, $35,000; draining ditches, $25,000; culverts, $15,000; entrance to aqueduct, $475,000; entrance gates, $100,000; bridges, $560,000; retaining walls, including $110,000 for additional plain concrete, $675,000; hydro-electric power house and equipment, $1,500,000; second filter unit, $900,000. It was explained that the test wall of the aqueduct had disclosed certain defects which made it essential to strengthen the two retaining walls at a cost of $675,000. Owing to the nature of the soil, the walls as originally designed were not strong enough, and the test wall had cracked at the base. It is proposed therefore to spend $565,000 on additional reinforced concrete work and better drainage, and $110,000 on unreinforced concrete work.

City Engineer a Paid Employee

The rights and powers of the City Engineer in the matter of altering plans and specifications in contracts for construction, and how far the contractor may expect payment for additional work so entailed, were illustrated in a judgment rendered in the Court of Appeals by Chief Justice Sir Horace Archambeault, confirming the judgment of the trial court in the case the Harris Construction Company vs. the City of Montreal, whereby the appellant's claim for $9,916 was held to be invalid.

The company appellant had undertaken sewer construction work for the city in 1913, and, having finished the work in 1914, had received payment of $193,900. The appellant made an additional claim for $21,591, which the city refused to pay, and an action resulted. In the course of the hearing the appellant made a further incidental claim for $9,916 for extra work, resulting from changes in the work which had been ordered by the City Engineer. The city alleged that such extra work had never been authorized, to which the appellant replied by the allegation that ever since the city had existed the work ordered by it had been executed on the orders of its engineers, that such orders had never been disputed, and that the custom of leaving the execution of the work to the discretion of the engineers was recognized by the city.

The city thereupon inscribed in law against this part of the appellant's answer, and the trial court sustained the inscription, declaring that the facts adduced were irrelevant to the main issue and would involve a long and useless inquiry. From this judgment the appeal was made. Though the company appellant admitted that no increase in price could be claimed by a contractor by tender according to plans and specifications without authorization in writing by the proprietor, it alleged that the City Engineer represented the city as holding a commission to have the work carried out, and that the changes ordered by him in writing were the act of the city itself.

"In the first place," said His Lordship in confirming the judgment, "the engineer who was charged by the city to superintend the work held no commission from the city, but was merely one of its paid employees. His powers are defined in the contract made between the appellant and the respondent, and he can in no wise obligate the city for a sum exceeding the total for which the contract has been awarded. Secondly, it must not be forgotten that the city is no ordinary proprietor; it is a corporation the powers of which are defined by a charter, and can legally incur obligations only in accordance with the terms of this charter. Moreover, Article 337 of the City Charter specifies that no contract whatever is binding upon the city unless first approved by the Council or Board of Control, and that the city is not responsible for the price or value of works done without the special authorization of the Council or Board of Control.

"This Article 337 ends by stating that no right of action against the city exists unless the formalities mentioned have been strictly observed, even if the city has benefited by the contract. It may be seen that an order from the City Engineer is not sufficient to bind the city. Therefore, when the company appellant alleges that the work carried out and for which it claims payment was ordered by the engineer charged with superintending the work it does not show that it has any right of action against the city. Even if the city had never disputed the orders of its Engineer in the past, it would not on that account have been bound by the order which may have been given by its Engineer in the extension of the present contract."

On this page we illustrate the cover of a new catalogue issued by Knox Motor Associates, Springfield, Mass. The catalogue is devoted to a description of the many varied applications of the Knox tractor, which is described as a motor vehicle which hauls its load after the manner of a railroad engine instead of carrying it as does the ordinary type of motor truck. By separating the power vehicle from the carrying vehicle it is claimed that not only can the efficiency of the power plant be multiplied, but also the uses to which the power may be put. This tractor allows from sixty to one hundred per cent. of the paying load to roll on steel tired trailers. Since the trailer may be detached from the tractor, there is no necessity to keep the tractor waiting for the loading or unloading of the trailer. The adaptability of this class of vehicle for hauling different kinds of material such as long sticks of lumber, structural steel, sand, blockstone, etc., is apparent. The number of trailers can be varied according to the class of material to be handled. In fact, the Knox tractor amounts practically to a trackless locomotive.

Knox Catalogue Cover Design.

What is said to be the largest country road contract ever let in America was executed last week under the award made by the commissioners of Multonomah County, Ore., which includes and surrounds the city of Portland. The bulk of the work is for hard surfacing with Warrenite under license of the patents of Warren Brothers Company, of Boston. This surfacing will be laid over the old macadam roads. Contracts aggregating $1,250,000 were let under bonds approved during the last winter. The allotment of contracts includes seventy-four miles to be surfaced with Warrenite, the work being divided amongst four contractors. The average cost of the work is approximately $14,000 a mile.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Blenheim, Ont.
The construction of cement sidewalks and curbs on various streets has been authorized by the Town Council. Engineer, C. E. Wharram.

Blind River, Ont.
Sidewalks, estimated to cost $3,500, will be constructed during the summer for the Town Council. Clerk, W. F. Dyke.

Brockville, Ont.
The Board of Works have been instructed by the Town Council to lay tarvia pavement on St. Audrew Street by day labor. Engineer, G. H. Broyson.

Hamilton, Ont.
The City Council have started work by day labor on the construction of sidewalks, estimated to cost $22,000, and watermains. Material is being purchased by A. P. Kappele, Secretary to the Works Department.

The City Council intend to lay a quantity of asphalt, asphaltic concrete and wood block paving by day labor. Material to be purchased by A. P. Kappele, Secretary to the Works Department.

Hensall, Ont.
Tenders will be called shortly by the Town Council for the construction of cement sidewalks on Alfred and Albert Streets. Clerk, A. Murdock.

Hull, Que.
The City Council have had plans drawn for sewers and watermains. Tenders will be called shortly. Estimated cost of watermains, $116,000. Clerk, N. Boulay.

Ingersoll, Ont.
The Town Council will receive tenders until July 5th for the construction of approximately 7,175 square yards of vitrified brick pavement on concrete base, with 3,500 feet of combined curb and gutter. Plans at office of the Town Clerk, W. R. Smith, and with the Contract Record, 347 Adelaide Street W., Toronto.

Kamsack, Sask.
The Town Council have authorized the construction of an addition to the waterworks system, estimated to cost $35,000. Clerk, H. H. Crawford.

Lambeth, Ont.
The Village Council are about to install a waterworks system, at an estimated cost of $15,000. Work will include well drilling. Engineers, J. A. Bell & Son.

Leamington, Ont.
It is proposed to lay a pavement on Erie Street this summer. Town Clerk, R. M. Selkirk.

London, Ont.
The City Council contemplate laying sewers into the Fair Grounds. Clerk, Samuel Baker.

The City Council are considering the construction of asphalt pavement on York and Talbot Streets. Engineer, H. A. Brazier.

The Water Commissioners propose to install an 8-inch watermain and fire hydrants in the Hillcrest Survey. Manager, E. V. Buchanan.

Millardville, Ont.
The estimated cost of the proposed municipal water installation is $8,175. Reeve, J. Marmont.

Mosa Township, Ont.
A quantity of tile drain construction is being considered by the Township Council. Clerk, C. C. McNaughton, Newbury, Ont.

New Glasgow, N. S.
The Town Council have decided to lay bitulithic pavement on Archimedes Street. Engineer, E. S. Fenser.

Oshawa, Ont.
The Town Council have passed a by-law to authorize the construction of sewers and concrete pavement on certain streets. Clerk, Thomas Morris.

Pelee Island Township, Ont.
Extensions to the drainage system are contemplated by the Township Council. Work will involve some blasting. Clerk, W. Stewart, Pelee Island P. O.

Plymouth Township, Ont.
The Township Council propose to construct a tile drain this season. Clerk, T. Nisbet, Wyoming P. O.

Prince Albert, Sask.
The City Council are considering the construction of a watermain on Fifteenth Street W., at an estimated cost of $14,000, and the laying of a sanitary sewer on the same street, estimated to cost $11,000. Clerk, J. H. Brown, Eighth Eighth Street East.

Quebec, Que.
The Civic Roads Committee have approved the following pavements:—Sacred Heart Street, $4,000; Marie Louise, St. Raphael and Montmagny Streets, $5,000; Beauport Road, $8,000; Charlesbourg Road, $6,000; Little River Road, $3,000. Engineer, W. D. Baillairge.

Renfrew, Ont.
The Town Council are about to lay macadam paving on Coombs and Hall Streets by day labor. Estimated cost, $7,750. Engineer, J. R. Stewart.

Regina, Sask.
The City Council have ordered that an early start be made on the following works:—waterworks, $44,500; watermains extensions, $10,680; domestic sewers, $11,324; street railway extensions, $10,000. Clerk, George Beach.

Rochester Township, Ont.
The Township Council are about to submit a by-law to provide for the expenditure of $30,000 on the construction of tile, stone and timber drains. Clerk, M. N. Rousseau, South Woodslee, Ont.

Scotstown, Que.
Work will shortly commence on the construction of pavements for the Town Council. Approximate cost, $5,000. Clerk, Samuel Boy.

St. John, N. B.
Work is about to start on the construction of sewers on Peter, Acadia and Chesley Streets for the City Council. Engineer, W. Murdock.

Stratford, Ont.
The City Council have approved the construction of cement sidewalks on several streets. Engineer, A. B. Manson.

Toronto, Ont.
The Board of Control will receive tenders until July 6th for one steam pump for hydraulic operation of gate valve at the High Level Pumping Station. Plans, etc., at Works Department, City Hall.

Trenton, N. S.
Plans for the construction of sewers have been submitted to the Town Council, and tenders will be called for shortly. Clerk, W. Fraser. Estimated cost, $3,300.

Waterloo, Ont.
Plans for the construction of concrete walks on various streets have been passed by the Town Council. Engineer, F. Moogk.

Windsor, Ont.
Tenders will be received until June 30th by the City Clerk, W. A. Hanrahan, for the supply of 300 tons of 6-inch, 80 tons of 8-inch and 700 tons of 20-inch cast iron water main, 10 tons of specials, five 20-inch, one 12-inch and two 10-inch valves.

CONTRACTS AWARDED

Bertie Township, Ont.
The contract for the construction of the Point Abino drain has been let to John D. Smith, Crystal Beach, Ont.

Blenheim, Ont.
A contract for the construction of sidewalks and curbs for the Town Council has been let to John Scoyne, at 10½c. per square foot for walks, 11½c. per foot for crossings and 19c. per lineal foot for curbs.

Brussels, Ont.
The Village Council have let the contract for laying a permanent roadway to Thomas McLean & Company, Wingham, at $2,950.

Humberstone, Ont.
The contract for the construction of sidewalks for the Village Council has been awarded to Chester Johnson, Ridgeway. Approximate cost, $3,500.

Kingston, Ont.
The Civic Utilities Commission have awarded a contract for waterworks construction to Kingston Construction Company, Limited, Kingston. Approximate cost, $5,000. City will lay pipe.

Lachine, Que.
The City Council have awarded the contract for the construction of a reser-

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